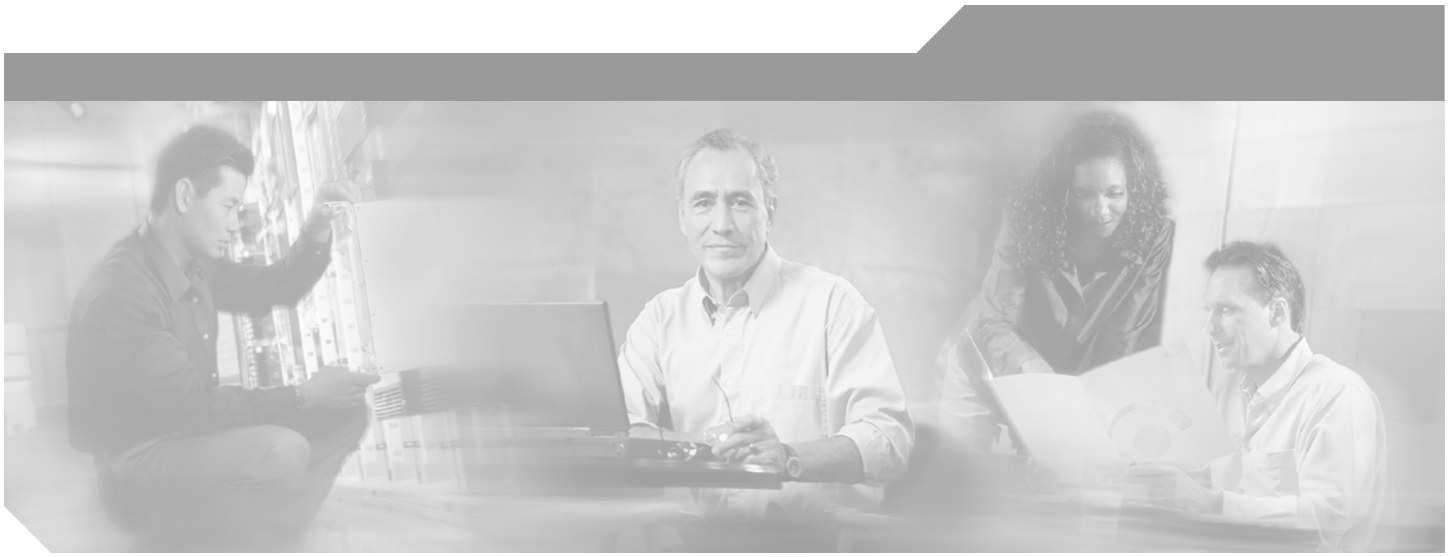

Cisco 7100 Series VPN Router Installation and Configuration Guide

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• Move the equipment to one side or the other of the television or radio.

• Move the equipment farther away from the television or radio.

• Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

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Preface

This installation guide explains the initial hardware installation and basic configuration procedures for the Cisco 7100 series VPN router.

This preface contains the following sections:

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Audience

To use this publication, you should be familiar not only with Cisco router hardware and cabling but also with electronic circuitry and wiring practices. You should also have experience as an electronic or electromechanical technician.

Installation Warning

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment.**

Waarschuwing **Deze apparatuur mag alleen worden geïnstalleerd, vervangen of hersteld door bevoegd geschoold personeel.**

Varoitus **Tämän laitteen saa asentaa, vaihtaa tai huoltaa ainoastaan koulutettu ja laitteen tunteva henkilökunta.**

Attention **Il est vivement recommandé de confier l'installation, le remplacement et la maintenance de ces équipements à des personnels qualifiés et expérimentés.**

Warnung **Das Installieren, Ersetzen oder Bedienen dieser Ausrüstung sollte nur geschultem, qualifiziertem Personal gestattet werden.**

Figyelem! **A berendezést csak szakképzett személyek helyezhetik üzembe, cserélhetik és tarthatják karban.**

Avvertenza **Questo apparato può essere installato, sostituito o mantenuto unicamente da un personale competente.**

Advarsel **Bare opplært og kvalifisert personell skal foreta installasjoner, utskiftninger eller service på dette utstyret.**

Aviso **Apenas pessoal treinado e qualificado deve ser autorizado a instalar, substituir ou fazer a revisão deste equipamento.**

¡Advertencia! **Solamente el personal calificado debe instalar, reemplazar o utilizar este equipo.**

Varning! **Endast utbildad och kvalificerad personal bör få tillåtelse att installera, byta ut eller reparera denna utrustning.**

Предупреждение Установку, замену и обслуживание этого оборудования может осуществлять только специально обученный квалифицированный персонал.

警告 只有经过培训且具有资格的人员才能进行此设备的安装、更换和维修。

警告 この装置の設置、交換、保守は、訓練を受けた相応の資格のある人が行ってください。

Document Organization

The major sections of this guide are as follows:

Chapter	Title	Description
1	Overview	Physical properties and functional overview of Cisco 7100 series VPN routers.
2	Preparing for Installation	Safety considerations, tools required, an overview of the installation, and procedures you should perform *before* the actual installation.
3	Installing a Cisco 7100 VPN Series Router	Installing the hardware and connecting the external network interface cables.
4	Performing a Basic Startup Configuration	Procedures for completing a basic system configuration and for checking and saving this configuration to system memory.
5	Troubleshooting the Installation	Basic troubleshooting procedures for the hardware installation.
A	Modular Port Adapter Configuration Guidelines	Bandwidth specifications and guidelines for installing port adapters in Cisco 7100 series VPN routers.
B	System Specifications	Physical specifications and power requirements of the router.
C	Cable Specifications	Cabling information and pinout information for the router.

Related Documentation

This section lists documentation related to your router and its functionality. The documentation mentioned is available online at Cisco.com, page xx, and on the Documentation CD-ROM, page xix.

Note We no longer ship the entire router documentation set automatically with each system. You must specifically order the documentation as part of the sales order. If you ordered documentation and did not receive it, we will ship the documents to you within 24 hours. To order documents, contact a customer service representative.

- For hardware installation and maintenance information for the Cisco 7100 series VPN routers, refer to the following documents:
  - For a complete list of Cisco series router hardware documentation, refer to the *Cisco 7100 Series VPN Router Documentation* flyer—DOC-7814391= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/products_product_index09186a00800fa142.html
  - *Cisco 7100 Series VPN Quick Start Guide*—DOC-786343= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/products_quick_start09186a00800a8557.html
  - *Cisco 7100 Series VPN Router Installation and Configuration Guide*—DOC-786341= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/products_installation_and_configuration_guide_book09186a008007cbe6.html

  - *Cisco 7100 Series VPN Router Regulatory Compliance and Safety Information*—DOC-786345= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/products_regulatory_approvals_and_compliance09186a0080119622.html
  - *Installing Field-Replaceable Units*—DOC-786344= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/prod_installation_guide09186a008007db0a.html
  - *Installing and Removing the Boot ROM in Cisco 7100 Series Routers*—DOC-7810156= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/prod_installation_guide09186a008009b16e.html
  - *Installing and Removing the Power Supply in Cisco 7100 Series Routers*—DOC-7810417= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/prod_installation_guide09186a008007db0b.html
  - *Integrated Service Adapter and Integrated Service Module Installation and Configuration* http://www.cisco.com/en/US/products/hw/modules/ps2957/products_module_installation_guide_book09186a008007dc9d.html
  - *VPN Acceleration Module (VAM) Installation and Configuration Guide* http://www.cisco.com/en/US/products/hw/routers/ps341/products_module_installation_guide_book09186a008010dfeb.html
  - Cisco 7100 series VPN router troubleshooting information: http://www.cisco.com/en/US/products/hw/vpndevc/ps333/prod_troubleshooting_technique09186a008014db1c.html
  - Cisco 7100 Tech Notes: http://www.cisco.com/en/US/products/hw/vpndevc/ps333/prod_tech_notes_list.html

- Port Adapter Installation and Configuration guides, available online at: http://www.cisco.com/en/US/products/hw/modules/ps2033/prod_module_installation_guides_list.html
  and
  http://www.cisco.com/en/US/products/hw/modules/ps2033/products_module_installation_guides_books_list.html

Note For specific port and service adapters for the Cisco 7100 series VPN routers, see the *Cisco 7100 Series VPN Router Documentation* flyer—DOC-7814391= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/products_product_index09186a00800fa142.html.

- For configuration information and support, refer to the modular configuration and modular command reference publications in the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware. Access these documents at: http://www.cisco.com/en/US/products/sw/iosswrel/index.html.

Note Select Translated documentation is available at http://www.cisco.com/ by selecting the topic ‘Select a Location / Language’ at the top of the page.

  - To determine the minimum Cisco IOS software requirements for your router, Cisco maintains the Software Advisor tool on Cisco.com. This tool does not verify whether modules within a system are compatible, but it does provide the minimum IOS requirements for individual hardware modules or components. Registered Cisco Direct users can access the Software Advisor at: http://www.cisco.com/cgi-bin/Support/CompNav/Index.pl.

- For IP security and encryption:
  - *Cisco IOS Enterprise VPN Configuration Guide*—DOC-786342= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/products_configuration_guide_book09186a008007dcb2.html
  - *Cisco IOS Interface Configuration Guide, Release 12.1* http://www.cisco.com/en/US/products/sw/iosswrel/ps1831/products_configuration_guide_book09186a0080088071.html
  - *Cisco IOS Interface Command Reference, Release 12.1* http://www.cisco.com/en/US/products/sw/iosswrel/ps1831/products_command_reference_book09186a00800880d1.html
  - *Cisco IOS Security Configuration Guide, Release 12.2* http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps1835/products_configuration_guide_book09186a0080087df1.html
  - *Cisco IOS Security Command Reference, Release 12.2* http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps1835/products_command_references_books_list.html
  - *Cisco IOS Security Configuration Guide, Release 12.1* http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps1831/products_configuration_guide_book09186a0080088254.html
  - *Cisco IOS Security Command Reference, Release 12.1* http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps1831/products_command_references_books_list.html
  - *Cisco IOS Release 12.0 Security Configuration Guide* http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps1828/products_configuration_guides_books_list.html
  - *Cisco IOS Release 12.0 Security Command Reference* http://www.cisco.com/en/US/partner/products/sw/iosswrel/ps1828/products_command_references_books_list.html
  - *Cisco IOS Quality of Service Solutions Configuration Guide, Release 12.2* http://www.cisco.com/en/US/products/sw/iosswrel/ps1835/products_configuration_guide_book09186a00800c5e31.html
  - *Cisco IOS Quality of Service Solutions Configuration Guide, Release 12.1* http://www.cisco.com/en/US/products/sw/iosswrel/ps1831/products_configuration_guide_book09186a008007ff1d.html
  - *Cisco IOS Release 12.0 Quality of Service Solutions Configuration Guide* http://www.cisco.com/en/US/products/sw/iosswrel/ps1828/products_configuration_guide_book09186a0080087c70.html
  - *Cisco IOS Interface Configuration Guide, Release 12.1* http://www.cisco.com/en/US/products/sw/iosswrel/ps1831/products_configuration_guide_book09186a0080088071.html

  - For FIPS 140 Security documents:
    http://www.cisco.com/en/US/partner/products/hw/routers/ps341/products_regulatory_approvals_and_compliance09186a00800f009e.html
  - For the VPN Device Manager documents:
    http://www.cisco.com/en/US/partner/products/sw/cscowork/ps2322/products_release_and_installation_notes_list.html

- If you are a registered Cisco Direct Customer, you can access the following tools:
  - Tools, Maintenance, and Troubleshooting Tips for Cisco IOS Software for Cisco IOS Release 12.0
    http://www.cisco.com/en/US/products/sw/iosswrel/ps1828/prod_troubleshooting_technique09186a008010929b.html
  - Tools, Maintenance, and Troubleshooting Tips for Cisco IOS Software for Cisco IOS Release 12.1
    http://www.cisco.com/en/US/products/sw/iosswrel/ps1831/prod_troubleshooting_technique09186a0080107cc7.html
  - Tools, Maintenance, and Troubleshooting Tips for Cisco IOS Software for Cisco IOS Release 12.2
    http://www.cisco.com/en/US/products/sw/iosswrel/ps1835/prod_troubleshooting_technique09186a00800f9050.html
  - Software Advisor
    http://www.cisco.com/en/US/partner/support/index.html
  - Bug Toolkit
    http://www.cisco.com/en/US/partner/products/hw/routers/ps341/prod_bug_toolkit.html
  - Bug Navigator
    http://www.cisco.com/cgi-bin/Support/Bugtool/launch_bugtool.pl
  - Feature Navigator
    http://www.cisco.com/en/US/partner/products/prod_feature_navigator_for_cisco_IOS_tool_launch.html
  - Output Interpreter
    https://www.cisco.com/cgi-bin/Support/OutputInterpreter/home.pl
  - Cisco IOS Error Message Decoder
    http://www.cisco.com/cgi-bin/Support/Errordecoder/home.pl
  - Cisco Dynamic Configuration Tool
    http://www.cisco.com/en/US/ordering/or13/or8/ordering_ordering_help_dynamic_configuration_tool_launch.html
  - MIB Locator
    http://tools.cisco.com/ITDIT/MIBS/servlet/index

- Additional tools include:
  - Tools Index
    http://www.cisco.com/en/US/partner/products/prod_tools_index.html
  - Cisco IOS Software Selector Tool
    http://tools.cisco.com/ITDIT/ISTMAIN/servlet/index

Document Conventions

Command descriptions use the following conventions:

boldface font	Commands and keywords are in **boldface**.
italic font	Arguments for which you supply values are in *italics*.
[ ]	Elements in square brackets are optional.
{ x | y | z }	Alternative keywords are grouped in braces and separated by vertical bars.
[x | y | z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string, or the string will include the quotation marks.

Screen examples use the following conventions:

`screen` font	Terminal sessions and information the system displays are in `screen` font.
`boldface screen` font	Information you must enter is in **`boldface screen`** font.
italic screen font	Arguments for which you supply values are in *italic screen* font.
^	The symbol ^ represents the key labeled **Control**—for example, the key combination ^D in a screen display means hold down the **Control** key while you press the **D** key.
< >	Nonprinting characters, such as passwords, are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Notes, cautionary statements, and safety warnings use these conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to materials not contained in this manual.

Caution Means *reader be careful*. You are capable of doing something that might result in equipment damage or loss of data.

Warning **This warning symbol means *danger*. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.**

Waarschuwing **Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen. Voor vertalingen van de waarschuwingen die in deze publicatie verschijnen, kunt u het document *Regulatory Compliance and Safety Information* (Informatie over naleving van veiligheids- en andere voorschriften) raadplegen dat bij dit toestel is ingesloten.**

Varoitus **Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista. Tässä julkaisussa esiintyvien varoitusten käännökset löydät laitteen mukana olevasta *Regulatory Compliance and Safety Information* -kirjasesta (määräysten noudattaminen ja tietoa turvallisuudesta).**

Attention **Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions d'avertissements figurant dans cette publication, consultez le document *Regulatory Compliance and Safety Information* (Conformité aux règlements et consignes de sécurité) qui accompagne cet appareil.**

Warnung **Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt. Übersetzungen der in dieser Veröffentlichung enthaltenen Warnhinweise finden Sie im Dokument *Regulatory Compliance and Safety Information* (Informationen zu behördlichen Vorschriften und Sicherheit), das zusammen mit diesem Gerät geliefert wurde.**

Avvertenza **Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti. La traduzione delle avvertenze riportate in questa pubblicazione si trova nel documento *Regulatory Compliance and Safety Information* (Conformità alle norme e informazioni sulla sicurezza) che accompagna questo dispositivo.**

Advarsel **Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker. Hvis du vil se oversettelser av de advarslene som finnes i denne publikasjonen, kan du se i dokumentet *Regulatory Compliance and Safety Information* (Overholdelse av forskrifter og sikkerhetsinformasjon) som ble levert med denne enheten.**

Aviso **Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes. Para ver as traduções dos avisos que constam desta publicação, consulte o documento *Regulatory Compliance and Safety Information* (Informação de Segurança e Disposições Reguladoras) que acompanha este dispositivo.**

¡Advertencia! **Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes. Para ver una traducción de las advertencias que aparecen en esta publicación, consultar el documento titulado *Regulatory Compliance and Safety Information* (Información sobre seguridad y conformidad con las disposiciones reglamentarias) que se acompaña con este dispositivo.**

Terms and Acronyms

To fully understand the content of this guide, you should be familiar with the following terms and acronyms:

- ABR—Available bit rate
- AAL5—ATM adaptation layer 5
- ATM-DXI—Asynchronous Transfer Mode-Data Exchange Interface
- AWG—American wire gauge
- CoS—Class of service
- CPE—Customer premises equipment
- CRC—Cyclic redundancy check
- CSU—Channel service unit
- CTS—Clear To Send
- DCD—Data Carrier Detect
- DCE—Data communications equipment
- DIMM—Dual in-line memory module
- DSR—Data set ready
- DSU—Data service unit
- DTE—Data terminal equipment
- DTR—Data terminal ready
- EMC—Electromagnetic compliance
- EMI—Electromagnetic interference
- ESD—Electrostatic discharge
- FRU—Field-replaceable unit (router components that do not require replacement by a Cisco-certified service provider)
- FTP—Foil twisted-pair
- HDLC—High-Level Data Link Control

- IGRP—Interior Gateway Routing Protocol
- ILMI—Integrated Local Management Interface
- IPSec—IP Security Protocol
- ISM—Integrated Service Module
- L2F/L2TP—Layer 2 Forwarding and Layer 2 Tunneling Protocol
- LANE—LAN emulation
- MAC—Media Access Control
- MB—Megabyte
- MM—Multimode
- nrt-VBR—Non-real time variable bit rate
- NVRAM—Nonvolatile random-access memory
- OAM AIS—Operation, Administration, and Maintenance alarm indication signal
- OIR—Online insertion and removal
- PCI—Peripheral Component Interconnect
- PCMCIA—Personal Computer Memory Card International Association
- PPP—Point-to-Point Protocol
- QoS—Quality of service
- rcp—remote copy protocol
- RFI—Radio frequency interference
- RIP—Routing Information Protocol
- RISC—Reduced Instruction Set Computing
- RTS—Request To Send
- SAR—Segmentation and reassembly
- SDRAM—Synchronous dynamic random-access memory
- SIMM—Single in-line memory module
- SMDS—Switched Multimegabit Data Service
- SMI—Single-mode intermediate reach
- SNMP—Simple Network Management Protocol
- TCP/IP—Transmission Control Protocol/Internet Protocol
- TDM—Time-division multiplexing
- TFTP—Trivial File Transfer Protocol
- UBR—Unspecified bit rate
- UDP—User Datagram Protocol
- UNI—User-Network Interface
- UTP—Unshielded twisted-pair
- VC—Virtual circuit
- VPN—Virtual Private Network

Obtaining Documentation

Cisco provides several ways to obtain documentation, technical assistance, and other technical resources. These sections explain how to obtain technical information from Cisco Systems.

Cisco.com

You can access the most current Cisco documentation on the World Wide Web at this URL:

http://www.cisco.com/univercd/home/home.htm

You can access the Cisco website at this URL:

http://www.cisco.com

International Cisco web sites can be accessed from this URL:

http://www.cisco.com/public/countries_languages.shtml

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Cisco documentation and additional literature are available in a Cisco Documentation CD-ROM package, which may have shipped with your product. The Documentation CD-ROM is updated monthly and may be more current than printed documentation. The CD-ROM package is available as a single unit or through an annual subscription.

Registered Cisco.com users can order the Documentation CD-ROM (product number DOC-CONDOCCD=) through the online Subscription Store:

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You can order Cisco documentation in these ways:

- Registered Cisco.com users (Cisco direct customers) can order Cisco product documentation from the Networking Products MarketPlace:

  http://www.cisco.com/en/US/partner/ordering/index.shtml

- Registered Cisco.com users can order the Documentation CD-ROM (Customer Order Number DOC-CONDOCCD=) through the online Subscription Store:

  http://www.cisco.com/go/subscription

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco Systems Corporate Headquarters (California, U.S.A.) at 408 526-7208 or, elsewhere in North America, by calling 800 553-NETS (6387).

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Obtaining Technical Assistance

Cisco provides Cisco.com, which includes the Cisco Technical Assistance Center (TAC) Website, as a starting point for all technical assistance. Customers and partners can obtain online documentation, troubleshooting tips, and sample configurations from the Cisco TAC website. Cisco.com registered users have complete access to the technical support resources on the Cisco TAC website, including TAC tools and utilities.

Cisco.com

Cisco.com offers a suite of interactive, networked services that let you access Cisco information, networking solutions, services, programs, and resources at any time, from anywhere in the world.

Cisco.com provides a broad range of features and services to help you with these tasks:

- Streamline business processes and improve productivity
- Resolve technical issues with online support
- Download and test software packages
- Order Cisco learning materials and merchandise
- Register for online skill assessment, training, and certification programs

To obtain customized information and service, you can self-register on Cisco.com at this URL:

http://www.cisco.com

Technical Assistance Center

The Cisco TAC is available to all customers who need technical assistance with a Cisco product, technology, or solution. Two levels of support are available: the Cisco TAC website and the Cisco TAC Escalation Center. The avenue of support that you choose depends on the priority of the problem and the conditions stated in service contracts, when applicable.

We categorize Cisco TAC inquiries according to urgency:

- Priority level 4 (P4)—You need information or assistance concerning Cisco product capabilities, product installation, or basic product configuration.

- Priority level 3 (P3)—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- Priority level 2 (P2)—Your production network is severely degraded, affecting significant aspects of business operations. No workaround is available.
- Priority level 1 (P1)—Your production network is down, and a critical impact to business operations will occur if service is not restored quickly. No workaround is available.

Cisco TAC Website

You can use the Cisco TAC website to resolve P3 and P4 issues yourself, saving both cost and time. The site provides around-the-clock access to online tools, knowledge bases, and software. To access the Cisco TAC website, go to this URL:

http://www.cisco.com/tac

All customers, partners, and resellers who have a valid Cisco service contract have complete access to the technical support resources on the Cisco TAC website. Some services on the Cisco TAC website require a Cisco.com login ID and password. If you have a valid service contract but do not have a login ID or password, go to this URL to register:

http://tools.cisco.com/RPF/register/register.do

If you are a Cisco.com registered user, and you cannot resolve your technical issues by using the Cisco TAC website, you can open a case online at this URL:

http://www.cisco.com/en/US/support/index.html

If you have Internet access, we recommend that you open P3 and P4 cases through the Cisco TAC website so that you can describe the situation in your own words and attach any necessary files.

Cisco TAC Escalation Center

The Cisco TAC Escalation Center addresses priority level 1 or priority level 2 issues. These classifications are assigned when severe network degradation significantly impacts business operations. When you contact the TAC Escalation Center with a P1 or P2 problem, a Cisco TAC engineer automatically opens a case.

To obtain a directory of toll-free Cisco TAC telephone numbers for your country, go to this URL:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

Before calling, please check with your network operations center to determine the level of Cisco support services to which your company is entitled: for example, SMARTnet, SMARTnet Onsite, or Network Supported Accounts (NSA). When you call the center, please have available your service agreement number and your product serial number.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- The *Cisco Product Catalog* describes the networking products offered by Cisco Systems as well as ordering and customer support services. Access the *Cisco Product Catalog* at this URL:

  http://www.cisco.com/en/US/products/products_catalog_links_launch.html

- Cisco Press publishes a wide range of networking publications. Cisco suggests these titles for new and experienced users: *Internetworking Terms and Acronyms Dictionary, Internetworking Technology Handbook, Internetworking Troubleshooting Guide,* and the *Internetworking Design Guide.* For current Cisco Press titles and other information, go to Cisco Press online at this URL:

  http://www.ciscopress.com

- *Packet* magazine is the Cisco monthly periodical that provides industry professionals with the latest information about the field of networking. You can access *Packet* magazine at this URL:

  http://www.cisco.com/en/US/about/ac123/ac114/about_cisco_packet_magazine.html

- *iQ Magazine* is the Cisco monthly periodical that provides business leaders and decision makers with the latest information about the networking industry. You can access *iQ Magazine* at this URL:

  http://business.cisco.com/prod/tree.taf%3fasset_id=44699&public_view=true&kbns=1.html

- *Internet Protocol Journal* is a quarterly journal published by Cisco Systems for engineering professionals involved in the design, development, and operation of public and private internets and intranets. You can access the *Internet Protocol Journal* at this URL:

  http://www.cisco.com/en/US/about/ac123/ac147/about_cisco_the_internet_protocol_journal.html

- Training—Cisco offers world-class networking training, with current offerings in network training listed at this URL:

  http://www.cisco.com/en/US/learning/le31/learning_recommended_training_list.html

Overview

This chapter provides physical and functional overviews of Cisco 7100 series VPN routers and contains the following sections that describe router hardware, major components, and functions of hardware-related features:

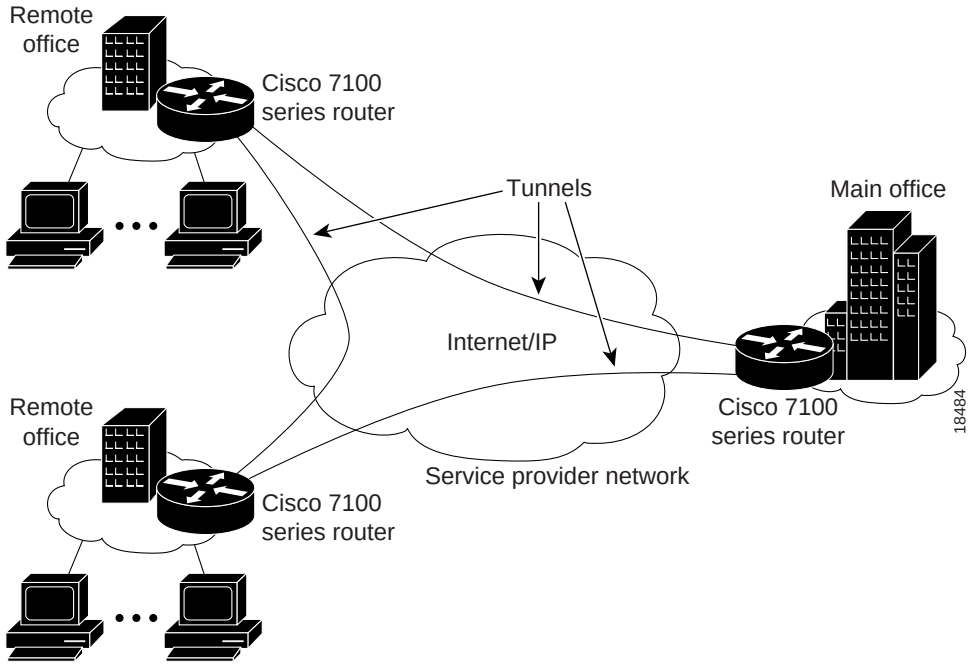
- Product Description, page 1-1
- Cisco 7120 Series Overview, page 1-5
- Cisco 7140 Series Overview, page 1-14
- Field-Replaceable Units, page 1-22
- Functional Overview, page 1-30

Product Description

Cisco 7100 series VPN routers support Virtual Private Networks (VPNs) and provide an integrated solution for security, quality of service (QoS), and service-level validation with emphasis on network technologies such as encryption and tunneling using IP Security (IPSec), Layer 2 Tunneling Protocol (L2TP), Generic Routing Encapsulation (GRE), and Layer 2 Forwarding (L2F) tunneling to ensure private transactions over public data networks. Cisco 7100 series VPN routers are designed for the enterprise WAN edge market and customer premises equipment (CPE) for the service provider as shown in Figure 1-1.

Note For more information on VPN software features, refer to the *Cisco 7100 Series VPN Configuration Guide* available online and on the Documentation CD.

Figure 1-1 Cisco 7100 Series Routers in a Virtual Private Network



Cisco 7100 series VPN routers include the following:

- Cisco 7120 series—Provides one fixed WAN port, two fixed 10BaseT/100BaseTX Fast Ethernet ports, one modular port adapter slot, and one service module slot.
- Cisco 7140 series—Provides two fixed WAN ports, two fixed 10BaseT/100BaseTX Fast Ethernet LAN ports, one modular port adapter slot, and one service module slot.

The Cisco 7120 series is available in six models, and the Cisco 7140 series is available in five models. The models are defined by the WAN interface.

Figure 1-2 shows the front of a Cisco 7100 series VPN router. The front of the router is the same on both Cisco 7120 series and Cisco 7140 series routers. The specific model number is located on the back of each unit.

Figure 1-2 Cisco 7100 Series—Front View

Cisco 7100 series VPN routers support the following features:

- Online insertion and removal (OIR)—Allows you to add, replace, or remove a modular port adapter without interrupting the system.
- Environmental monitoring and reporting functions—Allow you to maintain normal system operation by resolving adverse environmental conditions prior to loss of operation.

- Downloadable software—Allows you to load new images into Flash memory remotely, without having to physically access the router, for fast, reliable upgrades.
- Network management—Allows you to remotely manage the router. Cisco 7100 series VPN routers support CiscoWorks and CiscoView network management software.
  - CiscoWorks—Lets you monitor complex internetworks that use Cisco routing devices and helps you plan, troubleshoot, and analyze your network. CiscoWorks uses the Simple Network Management Protocol (SNMP) to monitor and control any SNMP device on the network.
  - CiscoView—A graphical SNMP-based device management tool that provides powerful real-time views of your networked Cisco devices. These views deliver a continuously updated physical picture of device configuration and performance conditions, with simultaneous views available for multiple device sessions. CiscoView runs from a centralized network management site from which you can review, reconfigure, and monitor essential device data from a simple GUI (that displays information such as dynamic status reports, performance statistics, and network inquiries) without having to physically check connections for each device, module, or port at every different or remote location.
- Integrated Service Module (ISM)—Provides Layer 3 encryption that supports IPSec encryption of IP datagrams.

Figure 1-3 shows a Cisco 7120 series router from the back and Figure 1-4 shows a Cisco 7140 series router. All interface connections and LEDs are located at the back of the router.

The Cisco 7100 series VPN routers have the following components:

- One fixed WAN port on the Cisco 7120 series—T1, T3, E3, or ATM (T3, E3, or OC-3c/STM1 single-mode intermediate reach).
- Two fixed WAN ports on the Cisco 7140 series—T3, E3, or ATM (T3, E3 OC-3c/STM1 multimode).
- Two fixed LAN ports—10BaseT/100BaseTX autosensing Ethernet/Fast Ethernet (full and half duplex) equipped with an RJ-45 receptacle.
- One modular port adapter slot—Supports one single-width port adapter.
- One service module slot—ISM provides encryption services.
- A Million Instructions Per Second (MIPS) Reduced Instruction Set Computing (RISC) network processor that supports VPN services at 50 Mbps in Cisco 7120 series routers and 90 Mbps in Cisco 7140 series routers.
- One console port—Equipped with an RJ-45 receptacle.
- One auxiliary port—Equipped with an RJ-45 receptacle.
- 280W AC-input power—Cisco 7120 series routers are equipped with one power supply and Cisco 7140 series routers are equipped with two power supplies for power load-sharing and redundancy.
- Two PC Card slots—Flash Disk or Flash memory cards contain the default Cisco IOS software image.
- LEDs—System ready, power, slot 0, slot 1, and LEDs for the fixed LAN and WAN ports.
- Up to 256 MB of synchronous dynamic random-access memory (SDRAM) system memory with 64 MB of fixed SDRAM packet memory—Three dual in-line memory modules (DIMMs) on the network processor board.

Figure 1-3 Cisco 7120 Series—Back View

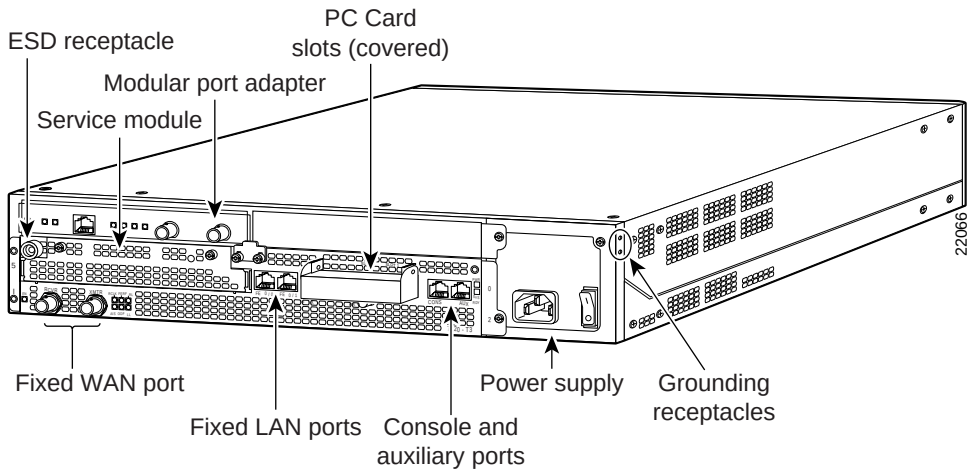
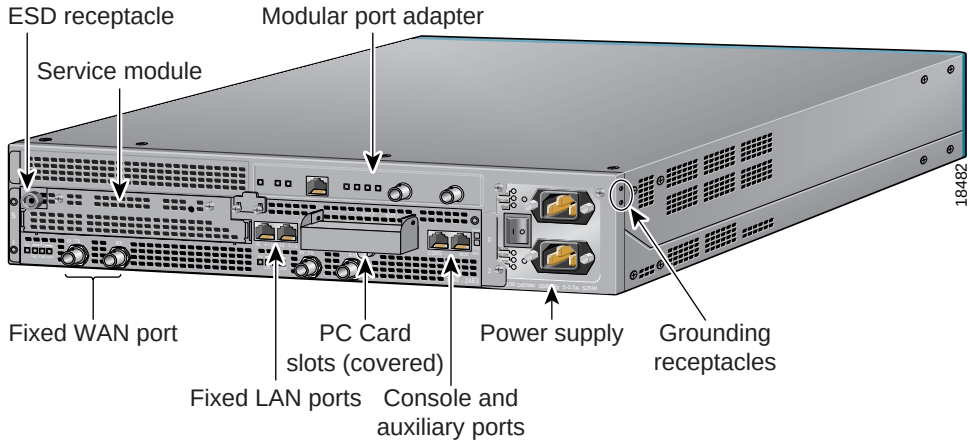


Figure 1-4 Cisco 7140 Series—Back View



Cisco 7120 series routers have one power supply with one AC-input power receptacle; Cisco 7140 series routers have two power supplies with two AC-input power receptacles for power load-sharing and redundancy. A modular power cable connects each AC-input power supply to the site AC power source. The router's main power switch is located next to the AC-input power receptacles.

Cisco 7140 series routers will operate with power connected to either of the two power supplies. The second AC-input power supply simply enables power load-sharing and redundancy. There is no primary or secondary power supply for Cisco 7140 series routers.

We recommend powering the router from a 15A receptacle at the power source.

On the side of each chassis are two chassis ground receptacles that provide a chassis ground connection for a two-hole grounding lug. On the back of the chassis, there is a receptacle for electrostatic discharge (ESD) equipment. (See Figure 1-3 and Figure 1-4.)

Four internal fans draw cooling air into the chassis (back to front) and across internal components to maintain an acceptable operating temperature. There are four environmental sensors for monitoring the cooling air as it leaves the chassis. For more information on environmental monitoring, see the "Environmental Monitoring and Reporting Functions" section on page 1-39.

Caution To ensure the proper flow of cooling air across the internal components, make sure a blank port adapter is installed in an unoccupied port adapter slot. The product number for a blank port adapter is MAS-7100-PABLANK=.

The modular port adapter slides into the chassis slot and connects directly to the router; there are no internal cables to connect.

The port adapter, service module, fixed WAN interfaces, and fixed LAN interfaces connect to two Peripheral Component Interconnect (PCI) buses on the router's backplane that provide a path to packet I/O memory and the system processor. For more information, see the "Peripheral Component Interconnect Buses" section on page 1-33.

Cisco 7100 series VPN routers can be installed on a tabletop or in an equipment rack. Rubber feet for tabletop installation are included in the accessory kit that shipped with your router. A rack-mount and cable-management kit is also standard equipment when Cisco 7100 series VPN routers are shipped from the factory. The kit provides the hardware needed to mount the router in a standard 19- or 23-inch, four-post or telco-type equipment rack. The kit also provides the hardware necessary to manage the interface cables attached to the router. The product number for the rack-mount kit is ACS-7100-RMK=. Instructions for setting the router on a tabletop, installing the router in an equipment rack, and attaching the cable-management bracket are the same for all Cisco 7100 series VPN models and are explained in Chapter 3, "Installing a Cisco 7100 VPN Series Router."

Cisco 7120 Series Overview

Cisco 7120 series routers include the following models:

- Cisco 7120-4T1—Provides four channel-independent, synchronous serial ports that support full-duplex operation at T1 (1.544-Mbps) and E1 (2.048-Mbps) speeds.
- Cisco 7120-T3—Provides one high-speed, synchronous serial port that supports full-duplex operation at T3 (45-Mbps) speeds.
- Cisco 7120-E3—Provides one high-speed, synchronous serial port that supports full-duplex operation at E3 (34-Mbps) speeds.
- Cisco 7120-AT3—Provides one high-speed, ATM port that supports full-duplex operation at T3 (45-Mbps) speeds.
- Cisco 7120-AE3—Provides one high-speed, ATM port that supports full-duplex operation at E3 (34-Mbps) speeds.
- Cisco 7120-SMI3—Provides one ATM port that supports full-duplex operation at OC-3c/STM1 single-mode intermediate reach (155-Mbps) speeds.

Cisco 7120-4T1

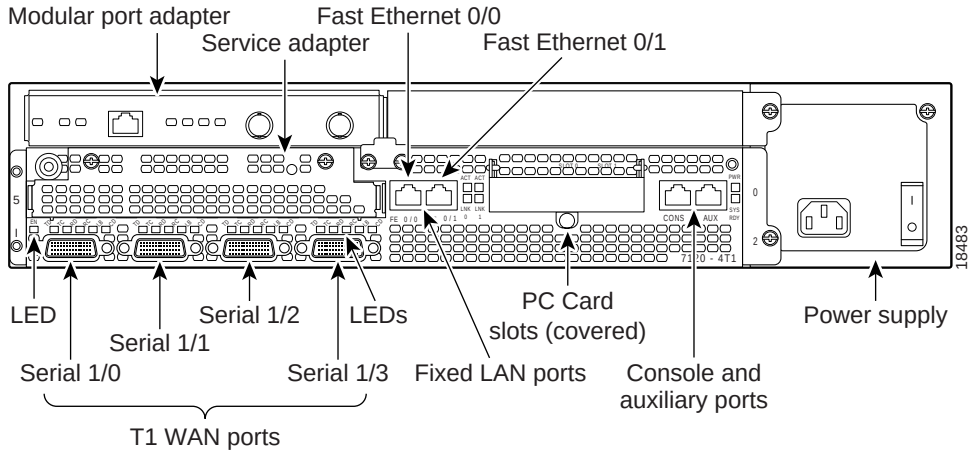
The Cisco 7120-4T1 provides four channel-independent, synchronous serial ports that support full-duplex operation at T1 (1.544-Mbps) and E1 (2.048-Mbps) speeds. The Cisco 7120-4T1 provides the following features:

- EIA/TIA-232, EIA/TIA-449, V.35, X.21, and EIA-530 interface types
- External (data terminal equipment [DTE] mode) or internal (data communications equipment [DCE] mode) timing signals (except for EIA-530, which only supports external)

- Loopbacks (except for X.21 DTE)
- ATM-DXI, Frame Relay, High-Level Data Link Control (HDLC), Point-to-Point Protocol (PPP), and Switched Multimegabit Data Service (SMDS) encapsulation
- RFC 1406 (except for the Frac table)

Figure 1-5 shows the back of the Cisco 7120-4T1. Access to the interfaces is located at the back of the router.

Figure 1-5 Cisco 7120-4T1—Back View



The Cisco 7120-4T1 WAN ports have one enabled (EN) LED and five status LEDs (each of the four ports has a set of status LEDs). After system initialization, the enabled LED goes on to indicate that all ports have been enabled for operation. If the initialization fails for any reason, the enabled LED will not go on. The LEDs are shown in Figure 1-6 and described in Table 1-1.

Figure 1-6 Cisco 7120-4T1 WAN Port LEDs

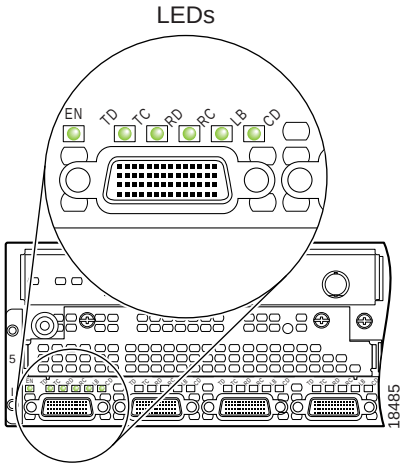


Table 1-1 Cisco 7120-4T1 LEd Descriptions

LED Label	Color	State	Function
EN	Green	On	Indicates ports are ready.
TD	Green	On	DTE—Transmit data out. DCE—Transmit data in.
TC	Green	On	DTE—Transmit clock in. DCE—Transmit clock in (TxCE).
RD	Green	On	DTE—Receive data in. DCE—Receive data out.
RC	Green	On	DTE—Receive clock in. DCE—Receive clock out.
LB/CD	Green	On	Indicates DTR[1], DSR[2], RTS[3], CTS[4], or DCD[5] is active.
	Green	Flashing	Indicates RTS, CTS, or DCD is sending and receiving data in half-duplex mode.
	Yellow	On	Indicates local loop or internal loop active.

1. DTR = Data Terminal Ready.
2. DSR = Data Set Ready.
3. RTS = Request To Send.
4. CTS = Clear To Send.
5. DCD = Data Carrier Detect.

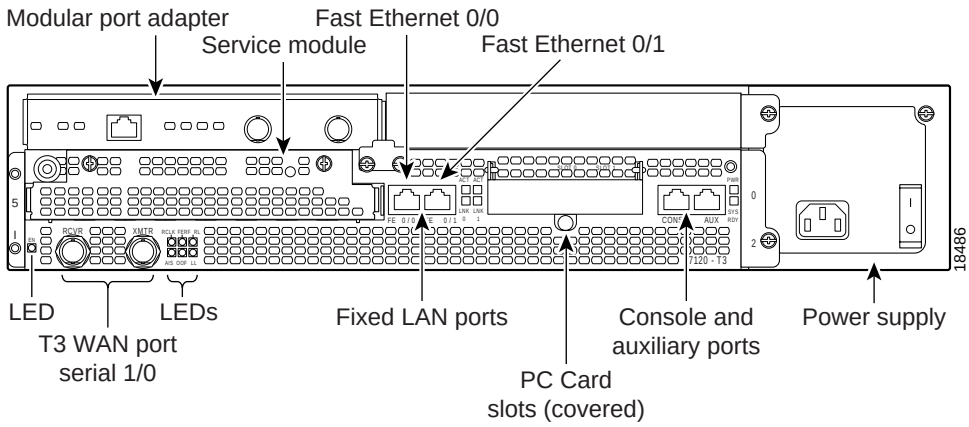
Cisco 7120-T3

The Cisco 7120-T3 provides one high-speed, synchronous serial port that supports full-duplex operation at T3 (45-Mbps) speeds. The Cisco 7120-T3 provides the following features:

- Integrated DSU functionality
- 16- and 32-bit CRCs
- B3ZS line coding
- Scrambling and bandwidth reduction
- Loopbacks
- ATM-DXI, Frame Relay, HDLC, SMDS, and PPP serial encapsulation
- RFC 1213 and RFC 1407

Figure 1-7 shows the back of the Cisco 7120-T3. Access to the interfaces is located at the back of the router.

Figure 1-7 Cisco 7120-T3—Back View



The Cisco 7120-T3 WAN port has one enabled LED and six uplink port status LEDs. After system initialization, the enabled LED goes on to indicate that the port has been enabled for operation. If the initialization fails for any reason, the enabled LED will not go on. The LEDs are shown in Figure 1-8 and described in Table 1-2.

Figure 1-8 Cisco 7120-T3 WAN Port LEDs

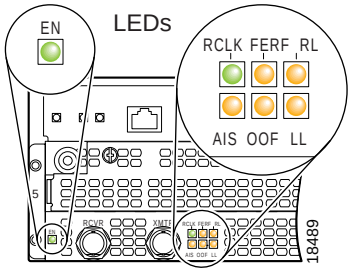


Table 1-2 Cisco 720-T3 LED Descriptions

LED Label	Color	State	Function
EN	Green	On	Indicates the port is ready.
RCLK	Green	On	Indicates a receive clock has been detected.
FERF	Yellow	On	Indicates the framer detected far-end receive failure.
RL	Yellow	On	Indicates the port is in remote loopback mode.
AIS	Yellow	On	Indicates the framer detected an alarm indication signal.
OOF	Yellow	On	Indicates the framer detected out of frame.
LL	Yellow	On	Indicates the port is in local loopback mode.

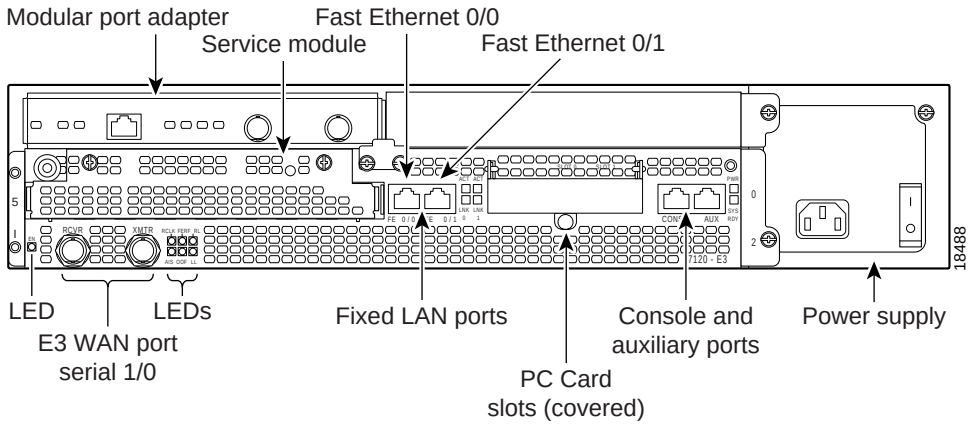
Cisco 7120-E3

The Cisco 7120-E3 provides one high-speed, synchronous serial port that supports full-duplex operation at E3 (34-Mbps) speeds. The Cisco 7120-E3 provides the following features:

- Integrated data service unit (DSU) functionality
- 16- and 32-bit cyclic redundancy checks (CRCs)
- HDB3 line coding
- Scrambling and bandwidth reduction
- G.751 framing or bypass framing
- National service bits
- Loopbacks
- ATM-DXI, Frame Relay, HDLC, SMDS, and PPP serial encapsulation
- RFC 1213 and RFC 1407

Figure 1-9 shows the back of the Cisco 7120-E3. Access to the interfaces is located at the back of the router.

Figure 1-9 Cisco 7120-E3—Back View



The Cisco 7120-E3 WAN port has one enabled LED and six uplink port status LEDs. After system initialization, the enabled LED goes on to indicate that the port has been enabled for operation. If the initialization fails for any reason, the enabled LED will not go on. The LEDs are shown in Figure 1-10 and described in Table 1-3.

Figure 1-10 Cisco 7120-E3 WAN Port LEDs

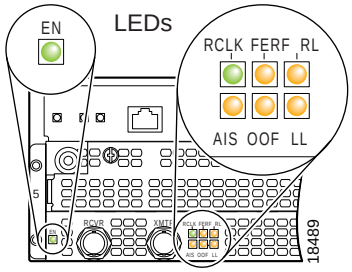


Table 1-3 Cisco 7120-E3 LED Descriptions

LED Label	Color	State	Function
EN	Green	On	Indicates the port is ready.
RCLK	Green	On	Indicates a receive clock has been detected.
FERF	Yellow	On	Indicates the framer detected far-end receive failure.
RL	Yellow	On	Indicates the port is in remote loopback mode.
AIS	Yellow	On	Indicates the framer detected an alarm indication signal.
OOF	Yellow	On	Indicates the framer detected out of frame.
LL	Yellow	On	Indicates the port is in local loopback mode.

Cisco 7120-AT3, Cisco 7120-AE3, and Cisco 7120-SMI3

The Cisco 7120-AT3 provides one high-speed, ATM port that supports full-duplex operation at T3 (45-Mbps) speeds. The Cisco 7120-AE3 provides one high-speed, ATM port that supports full-duplex operation at E3 (34-Mbps) speeds. The Cisco 7120-SMI3 provides one ATM port that supports full-duplex operation at OC-3c/STM1 single-mode intermediate reach (155-Mbps) speeds.

These models provide the following features:

- Up to 4096 total virtual circuits (open VCs)
- Up to 1024 simultaneous segmentations and reassemblies (SARs)
- ATM adaptation layer 5 (AAL5) for data traffic
- Traffic shaping on a per-VC basis
- IP-to-ATM class of service (CoS)
- Non-real time variable bit rate (nrt-VBR), unspecified bit rate (UBR), and available bit rate (ABR) quality of service (QoS)
- Operation, Administration, and Maintenance alarm indication signal (OAM AIS) cells
- LAN emulation (LANE)
- User-Network Interface (UNI) signaling
- Integrated Local Management Interface (ILMI)
- Loopbacks
- RFC 1483 and RFC 1577

Figure 1-11 shows the back of the Cisco 7120-AT3. Access to the interfaces is located at the back of the router.

Figure 1-11 Cisco 7120-AT3—Back View

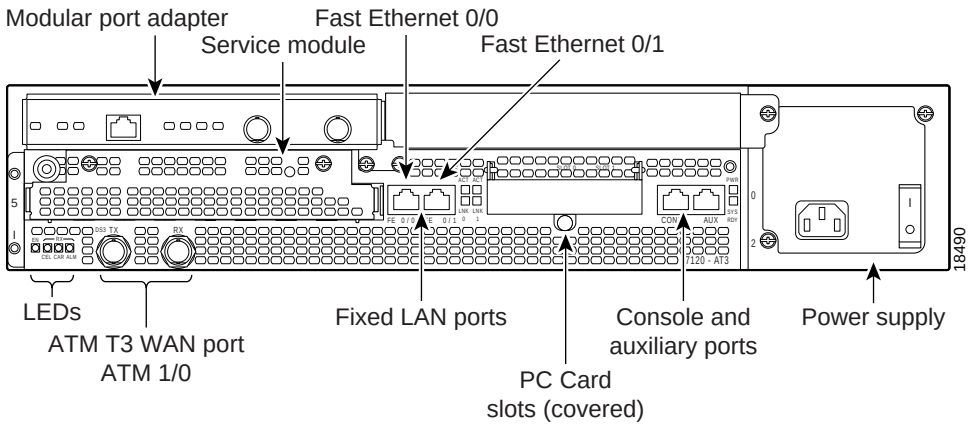


Figure 1-12 shows the back of the Cisco 7120-AE3. Access to the interfaces is located at the back of the router.

Figure 1-12 Cisco 7120-AE3—Back View

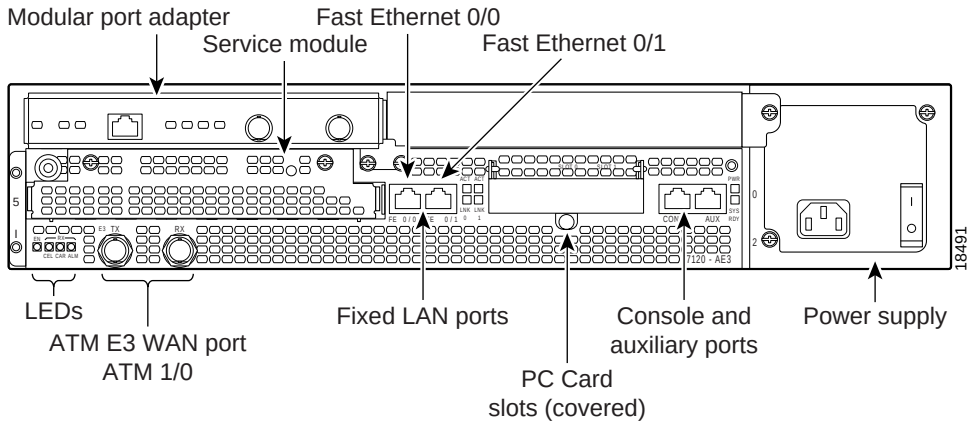
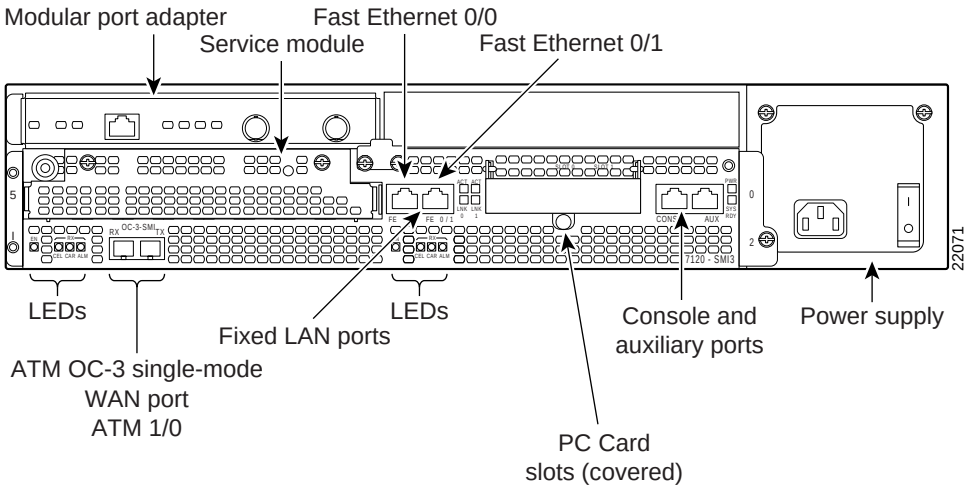


Figure 1-13 shows the back of the Cisco 7120-SMI3. Access to the interfaces is located at the back of the router.

Figure 1-13 Cisco 7120-SMI3—Back View



The Cisco 7120-AT3, Cisco 7120-AE3, and Cisco 7120-SMI3 WAN ports have one enabled LED and three status LEDs. The LEDs are in the same location and labeled the same on each model. After system initialization, the enabled LED goes on to indicate that the port has been enabled for operation. If the initialization fails for any reason, the enabled LED will not go on. The LEDs are shown in Figure 1-14 and described in Table 1-4.

Figure 1-14 Cisco 7120-AT3 WAN Port LEDs

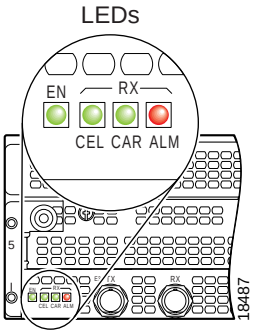


Table 1-4 Cisco 7120-AT3, Cisco 7120-AE3, and Cisco 7120-SMI3 LED Descriptions

LED Label	Color	State	Function
EN	Green	On	Indicates the port is ready.
RX CEL	Green	On	Indicates the port has received an ATM cell.
RX CAR	Green	On	Indicates the port has detected a carrier on the receiver cable. For a fiber-optic interface, this means that light is detected, and a valid frame is detected.
RX ALM	Red	On	Indicates the router detected an alarm condition.

Cisco 7140 Series Overview

Cisco 7140 series routers consist of the following models:

- Cisco 7140-2T3—Provides two high-speed, synchronous serial ports that support full-duplex operation at T3 (45-Mbps) speeds.
- Cisco 7140-2E3— Provides two high-speed, synchronous serial ports that support full-duplex operation at E3 (34-Mbps) speeds.
- Cisco 7140-2AT3—Provides two high-speed, ATM ports that support full-duplex operation at T3 (45-Mbps) speeds.
- Cisco 7140-2AE3—Provides two high-speed, ATM ports that support full-duplex operation at E3 (34-Mbps) speeds.
- Cisco 7140-2MM3—Provides two ATM ports that support full-duplex operation at OC-3c/STM1 multimode (155-Mbps) speeds.
- Cisco 7140-8T—Provides eight high-speed, synchronous serial ports that support full-duplex operation at T1 (1.544-Mbps) and E1 (2.048-Mbps) speeds.
- Cisco 7140-2FE—Provides two fixed LAN ports—10BaseT/100BaseTX autosensing Ethernet/Fast Ethernet (full and half duplex) equipped with an RJ-45 receptacle.

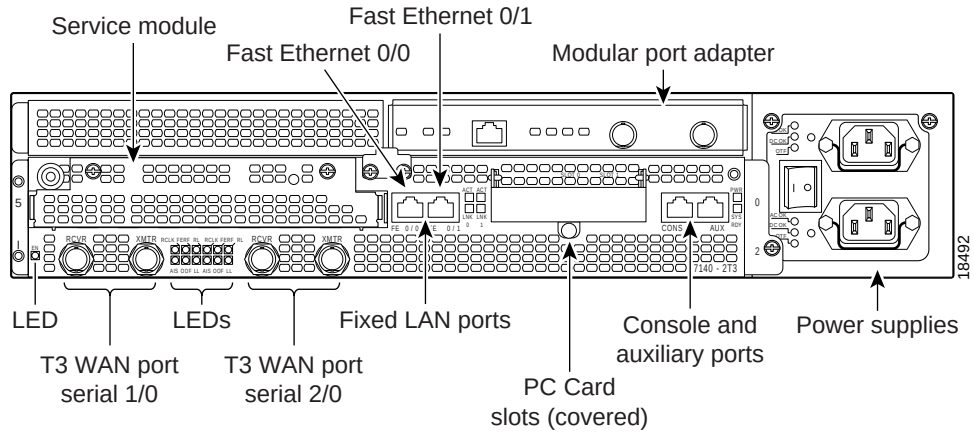
Cisco 7140-2T3

The Cisco 7140-2T3 provides two high-speed, synchronous serial ports that support full-duplex operation at T3 (45-Mbps) speeds. The Cisco 7140-2T3 provides the following features:

- Integrated DSU functionality
- 16- and 32-bit CRCs
- B3ZS line coding
- Scrambling and bandwidth reduction
- Loopbacks
- ATM-DXI, Frame Relay, HDLC, SMDS, and PPP serial encapsulation
- RFC 1213 and RFC 1407

Figure 1-15 shows the back of the Cisco 7140-2T3. Access to the interfaces is located at the back of the router.

Figure 1-15 Cisco 7140-2T3—Back View



The Cisco 7140-2T3 WAN ports have one enabled (EN) LED and six uplink port status LEDs (each port has a set of status LEDs). After system initialization, the enabled LED goes on to indicate that the ports have been enabled for operation. If the initialization fails for any reason, the enabled LED will not go on. The LEDs are shown in Figure 1-16 and described in Table 1-5.

Figure 1-16 Cisco 7140-2T3 WAN Port LEDs

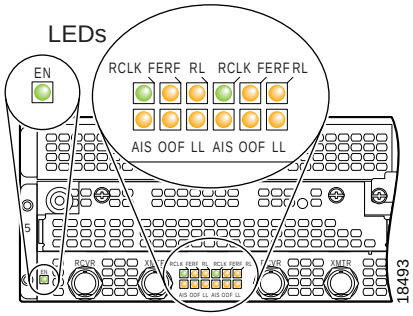


Table 1-5 Cisco 7140-2T3 LED Descriptions

LED Label	Color	State	Function
EN	Green	On	Indicates the port is ready.
RCLK	Green	On	Indicates a receive clock has been detected.
FERF	Yellow	On	Indicates the framer detected far-end receive failure.
RL	Yellow	On	Indicates the port is in remote loopback mode.
AIS	Yellow	On	Indicates the framer detected an alarm indication signal.
OOF	Yellow	On	Indicates the framer detected out of frame.
LL	Yellow	On	Indicates the port is in local loopback mode.

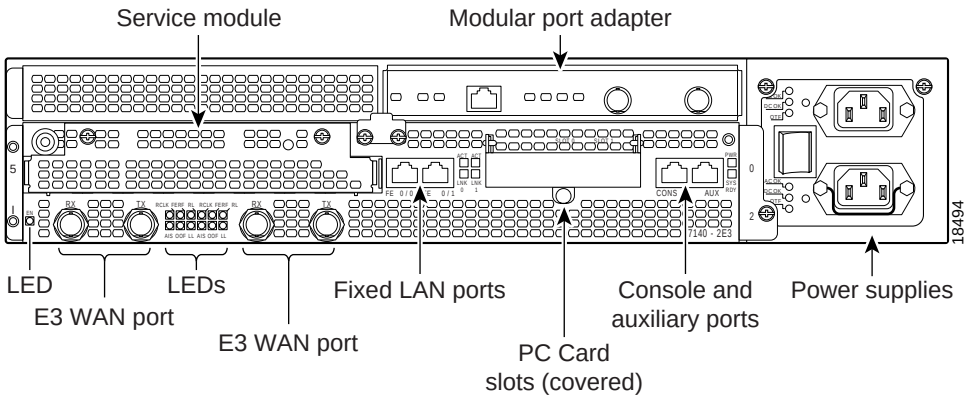
Cisco 7140-2E3

The Cisco 7140-2E3 provides two high-speed, synchronous serial ports that support full-duplex operation at E3 (34-Mbps) speeds. The Cisco 7140-2E3 provides the following features:

- Integrated DSU functionality
- 16- and 32-bit CRCs
- HDB3 line coding
- Scrambling and bandwidth reduction
- G.751 framing or bypass framing
- National service bits
- Loopbacks
- ATM-DXI, Frame Relay, HDLC, SMDS, and PPP serial encapsulation
- RFC 1213 and RFC 1407

Figure 1-17 shows the back of the Cisco 7140-2E3. Access to the interfaces is located at the back of the router.

Figure 1-17 Cisco 7140-2E3—Back View



The Cisco 7140-2E3 WAN ports have one enabled (EN) LED and six uplink port status LEDs (each port has a set of status LEDs). After system initialization, the enabled LED goes on to indicate that the ports have been enabled for operation. If the initialization fails for any reason, the enabled LED will not go on. The LEDs are shown in Figure 1-18 and described in Table 1-6.

Figure 1-18 Cisco 7140-2E3 WAN Port LEDs

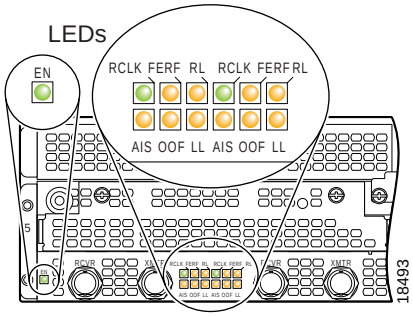


Table 1-6 Cisco 7140-2E3 LED Descriptions

LED Label	Color	State	Function
EN	Green	On	Indicates the port is ready.
RCLK	Green	On	Indicates a receive clock has been detected.
FERF	Yellow	On	Indicates the framer detected far-end receive failure.
RL	Yellow	On	Indicates the port is in remote loopback mode.
AIS	Yellow	On	Indicates the framer detected an alarm indication signal.
OOF	Yellow	On	Indicates the framer detected out of frame.
LL	Yellow	On	Indicates the port is in local loopback mode.

Cisco 7140-2AT3, Cisco 7140-2AE3, and Cisco 7140-2MM3

The Cisco 7140-2AT3 provides two high-speed, ATM ports that support full-duplex operation at T3 (45-Mbps) speeds. The Cisco 7140-2AE3 provides two high-speed, ATM ports that support full-duplex operation at E3 (34-Mbps) speeds. The Cisco 7140-2MM3 provides two ATM ports that support full-duplex operation at OC-3c/STM1 multimode (155-Mbps) speeds.

These models provides the following features:

- Up to 4096 total virtual circuits (open VCs)
- Up to 1024 simultaneous SARs
- ATM adaptation layer 5 (AAL5) for data traffic
- Traffic shaping on a per-VC basis
- IP-to-ATM CoS
- Non-real time variable bit rate (nrt-VBR), unspecified bit rate (UBR), and available bit rate (ABR) quality of service (QoS)
- Operation, Administration, and Maintenance alarm indication signal (OAM AIS) cells
- LAN emulation (LANE)

- User-Network Interface (UNI) signaling
- Integrated Local Management Interface (ILMI)
- Loopbacks
- RFC 1483 and RFC 1577

Figure 1-19 shows the back of the Cisco 7140-2AT3. Access to the interfaces is located at the back of the router.

Figure 1-19 Cisco 7140-2AT3—Back View

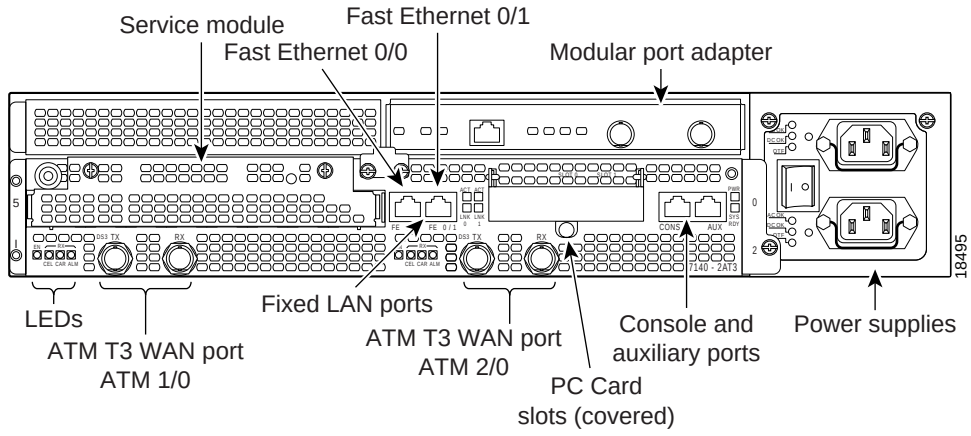


Figure 1-20 shows the back of the Cisco 7140-2AE3. Access to the interfaces is located at the back of the router.

Figure 1-20 Cisco 7140-2AE3—Back View

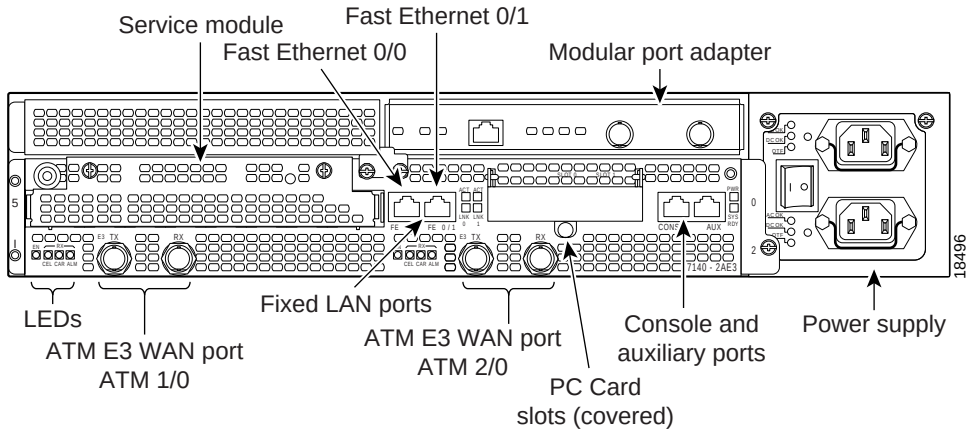
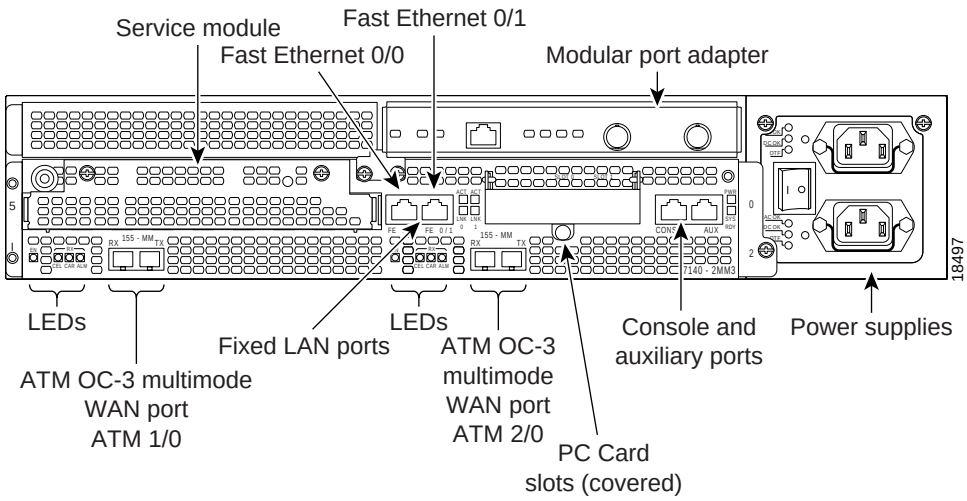


Figure 1-21 shows the back of the Cisco 7140-2MM3. Access to the interfaces is located at the back of the router.

Figure 1-21 Cisco 7140-2MM3—Back View



The Cisco 7140-2AT3, Cisco 7140-2AE3, and Cisco 7140-2MM3 WAN ports have one enabled (EN) LED and three status LEDs (each port has a set of status LEDs). The LEDs are in the same location and labeled the same on each model. After system initialization, the enabled LED goes on to indicate that the ports have been enabled for operation. If the initialization fails for any reason, the enabled LED will not go on. The LEDs are shown in Figure 1-22 and described in Table 1-7.

Figure 1-22 Cisco 7140-2AT3 WAN Port LEDs

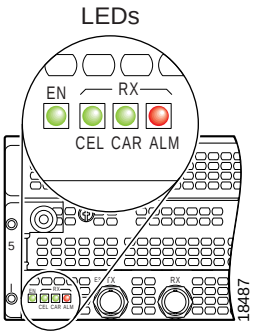


Table 1-7 Cisco 7140-2AT3, Cisco 7140-2AE3, and Cisco 7140-2MM3 LED Descriptions

LED Label	Color	State	Function
EN	Green	On	Indicates the port is ready.
RX CEL	Green	On	Indicates the port has received an ATM cell.
RX CAR	Green	On	Indicates the port has detected a carrier on the receiver cable. For a fiber-optic interface, this means that light is detected, and a valid frame is detected.
RX ALM	Red	On	Indicates the router detected an alarm condition.

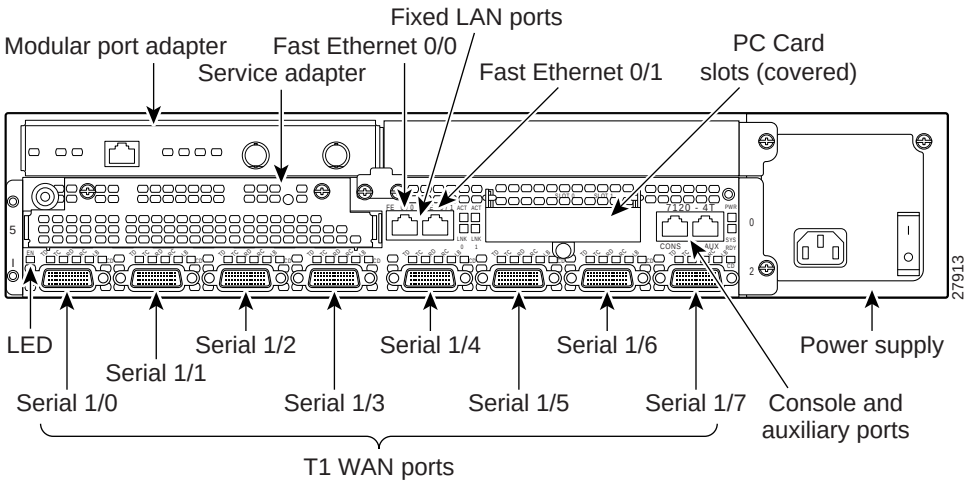
Cisco 7140-8T

The Cisco 7140-8T provides eight high-speed, synchronous serial ports that support full-duplex operation at T1 (1.544-Mbps) and E1 (2.048-Mbps) speeds. The Cisco 7140-8T provides the following features:

- EIA/TIA-232, EIA/TIA-449, V.35, X.21, and EIA-530 interface types
- External (data terminal equipment [DTE] mode) or internal (data communications equipment [DCE] mode) timing signals (except for EIA-530, which only supports external)
- Loopbacks (except for X.21 DTE)
- ATM-DXI, Frame Relay, High-Level Data Link Control (HDLC), Point-to-Point Protocol (PPP), and Switched Multimegabit Data Service (SMDS) encapsulation
- RFC 1406 (except for the Frac table)

Figure 1-23 shows the back of the Cisco 7140-8T. Access to the interfaces is located at the back of the router.

Figure 1-23 Cisco 7140-8T—Back View



The Cisco 7140-8T WAN ports have one enabled (EN) LED and five status LEDs (each of the eight ports has a set of status LEDs). After system initialization, the enabled LED goes on to indicate that all ports have been enabled for operation. If the initialization fails for any reason, the enabled LED will not go on. The LEDs are shown in Figure 1-24 and described in Table 1-8.

Figure 1-24 Cisco 7140-8T WAN Port LEDs

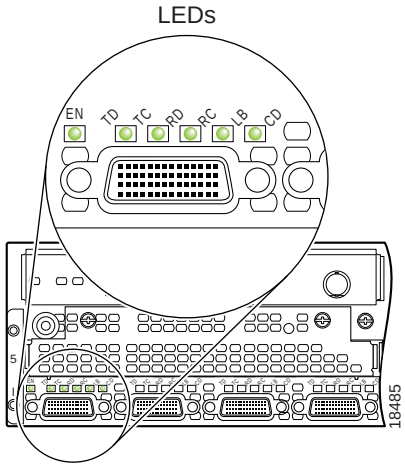


Table 1-8 Cisco 7140-8T LED Descriptions

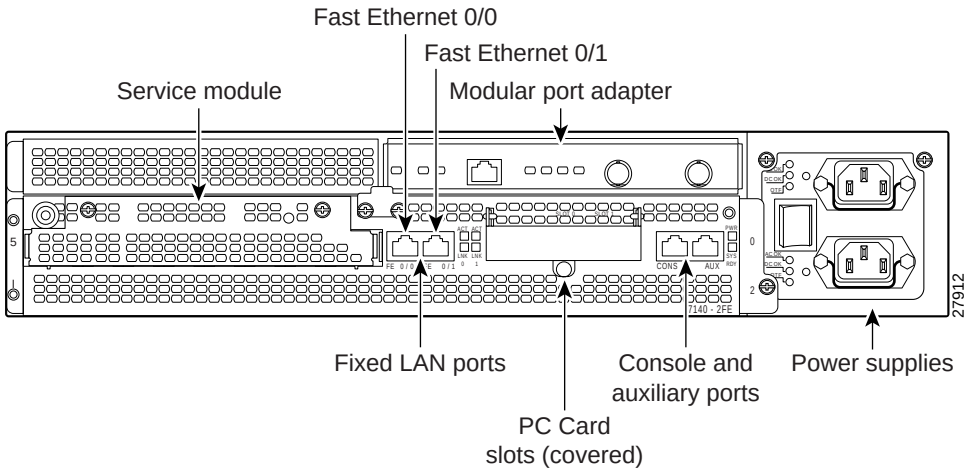
LED Label	Color	State	Function
EN	Green	On	Indicates ports are ready.
TD	Green	On	DTE—Transmit data out. DCE—Transmit data in.
TC	Green	On	DTE—Transmit clock in. DCE—Transmit clock in (TxCE).
RD	Green	On	DTE—Receive data in. DCE—Receive data out.
RC	Green	On	DTE—Receive clock in. DCE—Receive clock out.
Loopback/	Green	On	Indicates DTR[1], DSR[2], RTS[3], CTS[4], or DCD[5] is active.
Carrier Detect	Green	Flushing	Indicates RTS, CTS, or DCD is sending and receiving data in half-duplex mode.
	Yellow	On	Indicates local loop or internal loop active.

1. DTR = Data Terminal Ready.
2. DSR = Data Set Ready.
3. RTS = Request To Send.
4. CTS = Clear To Send.
5. DCD = Data Carrier Detect.

Cisco 7140-2FE

The Cisco 7140-2FE provides two fixed LAN ports—10BaseT/100BaseTX autosensing Ethernet/Fast Ethernet (full and half duplex) equipped with an RJ-45 receptacle.

Figure 1-25 Cisco 7140-2FE—Back View



Field-Replaceable Units

Cisco 7100 series VPN routers have the following field-replaceable units (FRUs):

- Port Adapters, page 1-23
- Integrated Service Module (ISM)/Integrated Service Adapter (ISA), page 1-23
- VPN Acceleration Module (VAM), page 1-26
- Flash Disks, page 1-27
- SDRAM Memory, page 1-28
- Rack-Mount and Cable-Management Kit, page 1-29

Note Replacement instructions for the rack-mount and cable-management kit, SDRAM memory, and Flash memory PC Cards are contained in the *Installing Field-Replaceable Units in Cisco 7100 Series VPN Routers* document.

Replacement instructions for removing and replacing other FRUs are contained in separate documents found online, and on the Documentation CD-ROM.

Port Adapters

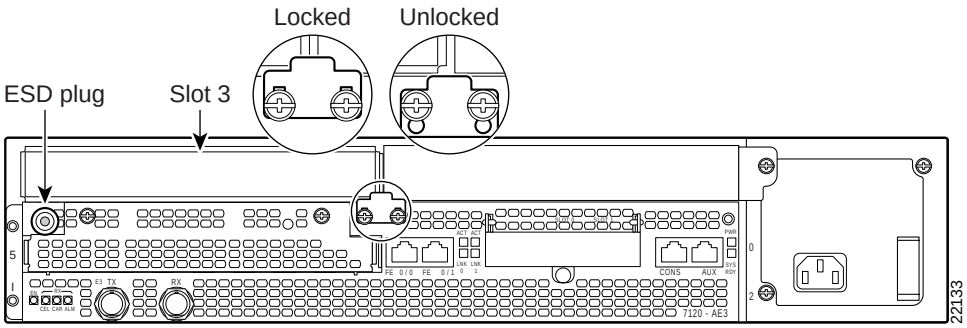
The port adapters installed in Cisco 7100 series VPN routers are of the same type as those installed in the Cisco 72xx family routers. For information on supported port adapters, refer to the *Cisco Product Catalog* or contact your local sales representative. The port adapters provide network interfaces to connect the router to external networks.

For a complete list of port adapters available to the Cisco 7100 series VPN routers, see the *Cisco 7100 Series VPN Router Documentation*—DOC-7814391= http://www.cisco.com/en/US/products/hw/vpndevc/ps333/products_product_index09186a00800fa142.html

All port adapters available for the Cisco 7100 series connect directly to the router and are locked into position by a locking tab with two screws (see Figure 1-26). To remove or replace a port adapter, you must loosen the screws (using a number 2 Phillips screwdriver) and slide the tab down. To lock the port adapter in place, slide the tab up and tighten the screws.

Note Detailed port adapter installation information is contained in the installation note for the port adapter. For example, if you plan to replace a four-port Ethernet port adapter in your Cisco 7100 series VPN router, refer to the *PA-4E Ethernet 10BaseT Port Adapter Installation and Configuration* note. The document is available online and on the Documentation CD-ROM.

Figure 1-26 Port Adapter Locking Tabs—Cisco 7120 Series



Caution To ensure adequate airflow across the router port adapters, a port adapter or a blank port adapter must be installed in each port adapter slot. The product number for the blank port adapter is MAS-7100-PABLANK=.

Integrated Service Module (ISM)/Integrated Service Adapter (ISA)

The ISM/ISA is a Layer 3 encryption module that supports IP Security Protocol (IPSec) encryption of IP datagrams. In addition to enabling the secure use of public switched networks and the Internet through encryption, the ISM/ISA supports all encryption features supported by the Cisco IOS software. The hardware-based services provided by the ISM/ISA improve the overall performance of Cisco 7100 series routers by off-loading data encryption processing from the main system processor.

For more information on ISM or ISA features and for installation and configuration information, refer to the *Integrated Service Adapter and Integrated Service Module Installation and Configuration* online. This document is also available on the Documentation CD-ROM.

Note The Cisco 7100 series VPN routers do not support an ISM and an ISA in the same chassis.

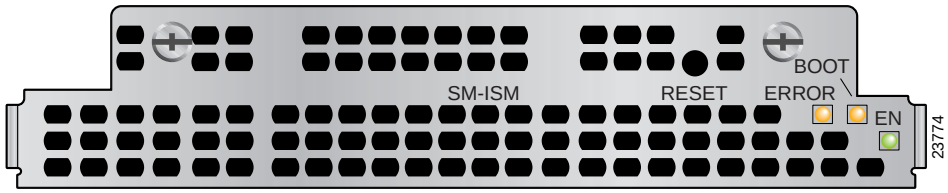
The boot LED remains lit when the ISA/ISM is configured for MPPE, and it starts to pulsate after booting when the ISA/ISM is configured for IPSec. The ISA/ISM functions normally whether the boot LED is pulsating or is solid. See the *Integrated Service Adapter and Integrated Service Module Installation and Configuration* for more information on configuring the ISA/ISM.

Caution To ensure compliance with U.S. export laws and regulations, and to prevent problems later on, refer to the "Compliance with U.S. Export Laws and Regulations Regarding Encryption" section in the *Regulatory Compliance and Safety Information for the Cisco 7100 Series VPN Routers* document for specific and important information.

ISM

The Integrated Service Module (ISM) is a service module that resides in slot 5 in Cisco 7100 series VPN routers. The ISM has three LEDs, as shown in Figure 1-27. Table 1-9 lists the colors and functions of the LEDs.

Figure 1-27 ISM LEDs



Note The physical orientation of the ISM LEDs is reversed from that of the ISA (see Figure 1-27).

Table 1-9 ISM LEDs

LED Label	Color	State	Function
EN	Green	On	Indicates the ISM is powered up and enabled for operation.
BOOT	Amber	Pulses[1]	Indicates the ISM is operating.
		On	Indicates the ISM is booting or a packet is being encrypted or decrypted.
ERROR	Amber	On	Indicates an encryption error has occurred. This LED is normally off.

1. After successfully booting, the boot LED pulses in a "heartbeat" pattern to indicate that the ISM is operating. As crypto traffic increases, the nominal level of this LED increases in proportion to the traffic level.

The following conditions must all be met before the enabled LED goes on:

- The ISM is correctly connected to the backplane and receiving power.

- The system bus recognizes the ISM.

If either of these conditions is not met, or if the router initialization fails for other reasons, the enabled LED does not go on.

Caution To ensure adequate airflow across the router components, an ISM or a blank service module must be installed in slot 5. The product number for the blank service module is SM-BLANK=.

ISA

The Integrated Service Adapter (ISA) is a service adapter that resides in slot 3 in Cisco 7120 series routers, and slot 4 in the Cisco 7140 series routers. The ISA has three LEDs, as shown in Figure 1-28. Table 1-10 lists the colors and functions of the ISA LEDs.

Figure 1-28 ISA Front Panel LEDs (SA-ISA shown)

Table 1-10 ISA LEDs

LED Label	Color	State	Function
ENABLE	Green	On	Indicates the ISA is powered up and enabled for operation.
BOOT	Amber	Pulses[1]	Indicates the ISA is operating.
		On	Indicates the ISA is booting or a packet is being encrypted or decrypted.
ERROR	Amber	On	Indicates an encryption error has occurred.
			This LED is normally off.

1. After successfully booting, the boot LED pulses in a “heartbeat” pattern to indicate that the ISA is operating. As crypto traffic increases, the nominal level of this LED increases in proportion to the traffic level.

The following conditions must all be met before the enabled LED goes on:

- The ISA is correctly connected to the backplane and receiving power.
- The system bus recognizes the ISA.

If either of these conditions is not met, or if the router initialization fails, the enabled LED does not go on.

VPN Acceleration Module (VAM)

The VPN Acceleration Module (VAM) is a single-width acceleration module. The VAM supports LAN/WAN media and full Layer 3 routing services. VAMs provide hardware-assisted tunneling and encryption services for virtual private network (VPN) remote access, site-to-site intranet and extranet applications, including security, quality of service (QoS), firewall and intrusion detection, and service-level validation and management. The VAM off-loads IPSec processing from the main processor to permit resources on the processor engines for other tasks. The VAM provides hardware-accelerated support for multiple encryption functions.

The VAM is available as a service adapter (SA-VAM), and as a service module (SM-VAM).

SA-VAM

The SA-VAM resides in slot 3 in the Cisco 7120 series routers, and slot 4 in the Cisco 7140 series routers. The SA-VAM has three LEDs, as shown in Figure 1-29. Table 1-11 lists the colors and functions of the SA-VAM LEDs.

Figure 1-29 SA-VAM LEDs

Table 1-11 SA-VAM LEDs

LED Label	Color	State	Function
ENABLE	Green	On	Indicates the VAM is powered up and enabled for operation.
BOOT	Amber	Pulses[1]	Indicates the VAM is operating.
		On	Indicates the VAM is booting or a packet is being encrypted or decrypted.
ERROR	Amber	On	Indicates an encryption error has occurred. This LED is normally off.

1. After successfully booting, the boot LED pulses in a “heartbeat” pattern to indicate that the VAM is operating. As crypto traffic increases, the nominal level of this LED increases in proportion to the traffic level.

The following conditions must be met before the enabled LED goes on:

- The SA-VAM is correctly connected to the backplane and receiving power.
- The system bus recognizes the SA-VAM.

If either of these conditions is not met, or if the router initialization fails, the enabled LED does not go on.

SM-VAM

The SM-VAM resides in slot 5 in the Cisco 7100 series VPN routers. The SM-VAM has three LEDs, as shown in Figure 1-30. Table 1-12 lists the colors and functions of the LEDs.

Figure 1-30 SM-VAM LEDs

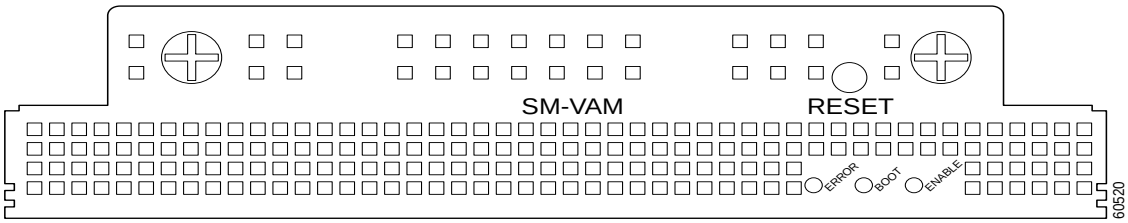


Table 1-12 SM-VAM LEDs

LED Label	Color	State	Function
ERROR	Amber	On	Indicates an encryption error has occurred. This LED is normally off.
BOOT	Amber	Pulses[1]	Indicates the SM-VAM is operating.
		On	Indicates the SM-VAM is booting or a packet is being encrypted or decrypted.
ENABLE	Green	On	Indicates the SM-VAM is powered up and enabled for operation.

1. After successfully booting, the boot LED pulses in a "heartbeat" pattern to indicate that the VAM is operating. As crypto traffic increases, the nominal level of this LED increases in proportion to the traffic level.

The following conditions must be met before the enabled LED goes on:

- The SM-VAM is correctly connected to the backplane and receiving power.
- The system bus recognizes the SM-VAM.

If either of these conditions is not met, or if the router initialization fails for other reasons, the enabled LED does not go on.

Flash Disks

A Flash Disk is the default memory device that ships with your Cisco 7100 series VPN router.

Cisco 7100 series VPN routers support up to two installed Flash Disks that contain the default Cisco IOS software image. Flash Disks can be installed in slot 0 and slot 1 of the PC Card slots located at the back of the router. Slot 0 is the top slot and slot 1 is the bottom slot.

The PC Card must be installed with the back label facing up. The PC Card is keyed and cannot be seated the wrong way. The ejector button will not pop out if the card is not completely inserted.

To ensure proper electromagnetic compatibility (EMC), the PC Card slot has a cover that is secured with a captive screw. To install or remove a Flash Disk from slot 0 or slot 1, you must loosen the captive screw.

Note To avoid potential problems when you install spare Flash Disks in the router, we recommend that you reformat all Flash Disks on a Cisco 7100 series VPN router that is running the Cisco IOS release recommended for your router during your regularly scheduled service times. The Flash Disk requires the designation **disk0** or **disk1** to format it.

See the *Using the Flash Disk* document for additional information on the Flash Disk.This document is also available on cisco.com and on the Documentation CD-ROM.

Table 1-13 lists the Flash Disk memory options and their product numbers.

Table 1-13 Flash Disk Memory Options

Memory Size	Product Number[1]
48 MB	MEM-7100-FLD48M
128 MB	MEM-7100-FLD128M

1. These products are also available as Flash Disk upgrades. To order an upgrade, add an equal sign (=) after the product number, for example, MEM-7100-FLD48M=.

Note Flash memory cards that are used in Cisco 7200 series and Cisco 7500 series routers are also supported on Cisco 7100 series routers. For information on the Flash memory card, refer to the *Installing Field-Replaceable Units in Cisco 7100 Series VPN Routers* document, available on cisco.com and on the Documentation CD-ROM.

SDRAM Memory

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment. This equipment contains an energy hazard. Disconnect the system before servicing.**

SDRAM memory consists of three DIMMs on the network processor card that contain the packet and system memory. By default, each chassis comes with 64 MB of fixed packet memory and 64 MB of upgradable system memory. You can have up to 256 MB of SDRAM system memory. (For more information on the network processor, see the "Network Processor Card" section on page 1-34.)

Note For information on how to replace the SDRAM memory, refer to the *Installing Field-Replaceable Units in Cisco 7100 Series VPN Routers* available online and on the Documentation CD.

Table 1-14 lists the SDRAM product numbers.

Table 1-14 SDRAM DIMM Configurations

Total SDRAM	Memory Configuration	Product Number
64 MB[1]	1 64-MB DIMM in slot DIMM 1	MEM-7120/40-64S(=)
	1 64-MB DIMM in slot DIMM 0[2]	MEM-7120/40-64P
128 MB[3]	1 128-MB DIMM in slot DIMM 1	MEM-7120/40-128S=
192 MB	1 128-MB DIMM in slot DIMM 1 and 1 64-MB DIMM in slot DIMM 2	MEM-7120/40-192P=
256 MB	2 128-MB DIMMs; 1 in each slot (DIMM 1 and DIMM 2)	MEM-7120/40-256P=

1. This is the default memory configuration for all Cisco 7100 series routers.
2. Slot DIMM 0 is used exclusively for packet memory and is fixed at 64 MB.
3. This memory product will be available in the future.

Note The amount of memory installed in slot DIMM 1 must be greater than or equal to the amount of memory installed in slot DIMM 2, and slot DIMM 2 can be zero.

Slot DIMM 0 is used exclusively for packet memory and is fixed at 64 MB in the factory.

Rack-Mount and Cable-Management Kit

The rack-mount and cable-management kit for Cisco 7100 series routers consists of rack-mount brackets and a cable-management bracket that are designed for mounting your router in 19- or 23-inch, four-post or telco-type equipment racks. The kit is shipped with each Cisco 7100 series router and is also available as a single FRU. The product number for the rack-mount and cable-management kit is ACS-7100-RMK=.

Note Rubber feet for tabletop installation are included in the accessory kit that shipped with your router. (See the "Setting the Chassis on a Tabletop" section on page 3-1.)

For detailed instructions about how to install the rack-mount and cable-management brackets on your Cisco 7100 series router, see the "Rack-Mounting the Chassis" section on page 3-2 and the "Connecting to the Network" section on page 3-7.

Note Information on how to install the rack-mount and cable-management brackets is in the *Installing Field-Replaceable Units in Cisco 7100 Series VPN Routers* document available online and on the Documentation CD.

Functional Overview

The following sections provide a functional overview of Cisco 7100 series VPN routers to help you become familiar with the capabilities of the router:

- Chassis Slot and Logical Interface Numbering, page 1-30
- Online Insertion and Removal, page 1-33
- Peripheral Component Interconnect Buses, page 1-33
- Network Processor Card, page 1-34
- System LEDs and Reset Button, page 1-38
- Environmental Monitoring and Reporting Functions, page 1-39

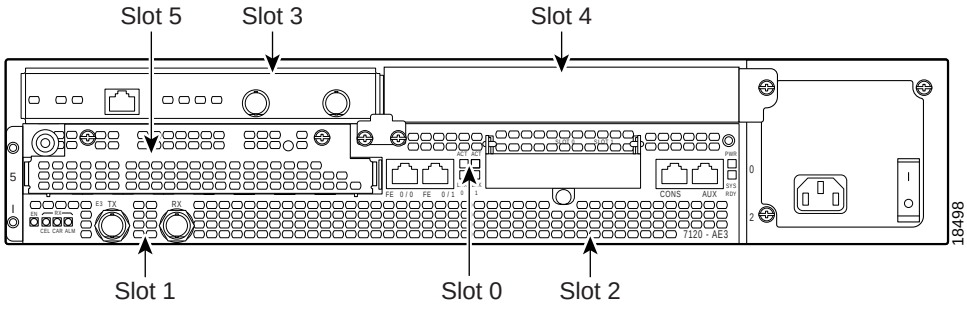
Chassis Slot and Logical Interface Numbering

In Cisco 7100 series VPN routers, the s*lot number* is the location in the chassis where the interface resides and the *port number* is the physical port associated with that slot. Cisco 7100 series router slots are numbered 0 through 5. Interfaces in the Cisco IOS software are identified by a type, slot number, and port number. The number of physical ports depends on the type of modular port adapter or fixed interface. For example, in a Cisco 7120-4T1, serial 1/0 indicates port 0 on the fixed serial interface in slot 1. (See Figure 1-5.)

Slots in the Cisco 7120 series are numbered as follows and are shown in Figure 1-31:

- Slot 0—Fixed LAN (Ethernet) interface
- Slot 1—Fixed WAN (serial) interface
- Slot 2—Not used
- Slot 3—Modular port adapter
- Slot 4—Not used
- Slot 5—Integrated Service Module

Figure 1-31 Port Adapter Slot Numbering—Cisco 7120 Series

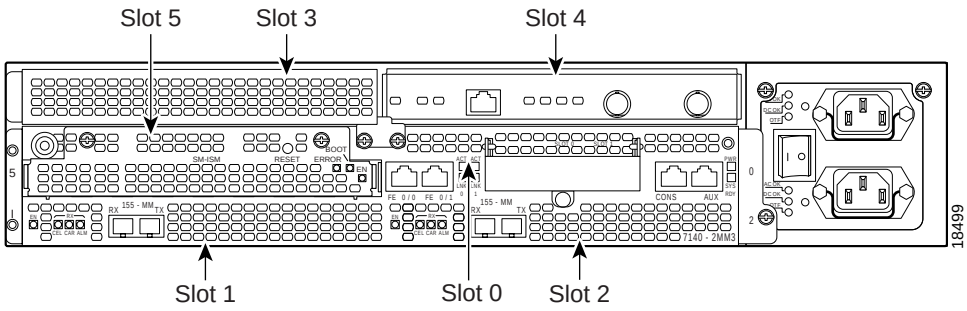


Slots in the Cisco 7140 series are numbered as follows and are shown in Figure 1-32:

- Slot 0—Fixed LAN (Ethernet) interface
- Slot 1—Fixed WAN (serial) interface
- Slot 2—Fixed WAN (serial) interface

- Slot 3—Not used
- Slot 4—Modular port adapter
- Slot 5—Integrated Service Module

Figure 1-32 Port Adapter Slot Numbering—Cisco 7140 Series



Interface Information in the Software

You can identify interfaces by using software commands. To display information about all interfaces, use the **show interfaces** command. To display information about a specific interface, use the **show interfaces** command with the interface type, slot number, and port number in the format **show interfaces** *type slot*/*port*.

The following example shows how the **show interfaces** command, used without arguments, displays status information (including the slot and port number) for each interface in a Cisco 7100 series VPN router. In the following example, most of the status information for each interface is omitted:

```
Router# show interfaces
FastEthernet0/0 is up, line protocol is up
  Hardware is DEC21140A, address is 0050.73ff.6300 (bia 0050.73ff.6300)
  Internet address is 10.0.0.0/1
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
     (display text omitted)

FastEthernet0/1 is administratively down, line protocol is down
  Hardware is DEC21140A, address is 0050.73ff.6301 (bia 0050.73ff.6301)
  Internet address is 10.0.0.0/2
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
    (display text omitted)

Serial1/0 is administratively down, line protocol is down
  Hardware is M2T-T3 pa
  MTU 4470 bytes, BW 44210 Kbit, DLY 200 usec,
    (display text omitted)

Serial1/1 is administratively down, line protocol is down
  Hardware is M2T-T3 pa
  MTU 4470 bytes, BW 44210 Kbit, DLY 200 usec,
     (display text omitted)

FastEthernet4/0 is administratively down, line protocol is down
  Hardware is DEC21140, address is 0050.73ff.6370 (bia 0050.73ff.6370)
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,
   (display text omitted)
```

```
You can also use arguments such as the interface type (Ethernet, Token Ring, ATM, and so
forth) and the slot/port number to display information about a specific interface only.
The following example shows the display for the fixed LAN (Fast Ethernet interface) port 0
in slot 0:
Router# show interfaces fastethernet 0/0
FastEthernet0/0 is up, line protocol is up
  Hardware is DEC21140A, address is 0050.73ff.6300 (bia 0050.73ff.6300)
  Internet address is 10.0.0.0/1
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
     reliablility 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Half-duplex, 10Mb/s, 100BaseTX/FX
  ARP type:ARPA, ARP Timeout 04:00:00
  Last input 00:00:04, output 00:00:03, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy:fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 2000 bits/sec, 1 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     134 packets input, 41451 bytes
     Received 134 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast
     0 input packets with dribble condition detected
     26 packets output, 5281 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
```

For information on the other commands used to configure the router, refer to the Cisco IOS configuration guides and command references, which are available on the Documentation CD-ROM or in print.

MAC Addresses

The *Media Access Control (MAC)* or *hardware* address is a standardized data-link layer address that is required for certain network interface types. These addresses are not used by other devices in the network; they are specific and unique to each port. The router uses a specific method to assign and control the MAC addresses of its port adapters.

All LAN interfaces (ports) require unique MAC addresses. Typically, the MAC address of an interface is stored on a memory component that resides directly on the interface circuitry; however, the online insertion and removal (OIR) feature requires a different method. (For a description of OIR, see "Online Insertion and Removal" section on page 1-33.)

The OIR feature allows you to remove a port adapter and replace it with another identically configured one. If the new port adapter matches the port adapter you removed, the system immediately brings it on line. To allow OIR, an address allocator with unique MAC addresses is stored in an EEPROM on the router. Each address is reserved for a specific port and slot in the router regardless of whether a port adapter resides in that slot. The MAC addresses are assigned to slot 3 in Cisco 7120 series routers and slot 4 in Cisco 7140 series routers. This address scheme allows you to remove a port adapter and insert the port adapter into other routers without causing the MAC addresses to move around the network or be assigned to multiple devices.

If the MAC addresses were stored on each port adapter, OIR would not function because you could never replace one port adapter with an identical one; the MAC addresses would always be different. Also, each time a port adapter was replaced, other devices on the network would have to update their data structures with the new address and, if they did not do so quickly enough, could cause the same MAC address to appear in more than one device at the same time.

Note Storing the MAC addresses for every slot in one central location means the addresses stay with the memory device on which they are stored.

Online Insertion and Removal

The modular port adapter installed in Cisco 7100 series VPN routers supports OIR. This function allows you to install and replace a port adapter while the router is operating; you do not need to notify the software or shut down the system power. This provides a method that is seamless to end users on the network, maintains all routing information, and preserves sessions.

The following is a functional description of OIR for background information only; for specific procedures for installing and replacing a port adapter in a Cisco 7100 series VPN router, see the configuration note that ships with each port adapter.

Each port adapter has a bus connector that connects it to the router. Each connector has a set of tiered pins in three lengths that send specific signals to the system as they make contact with the port adapter. The system assesses the signals it receives and the order in which it receives them to determine if a port adapter is being removed or inserted into the router. From these signals, the system determines whether to reinitialize a new interface or shut down a removed interface. For example, when you insert a port adapter, the longest pins make contact with the port adapter first, and the shortest pins make contact last. The system recognizes the signals and the sequence in which it receives them.

When you remove or insert a port adapter in a Cisco 7100 series VPN router, the port adapter pins send signals to notify the system, which then performs as follows:

1. Rapidly scans the system for configuration changes.
2. Initializes all newly inserted port adapters, noting any removed interfaces and placing them in the administratively shutdown state.
3. Brings all previously configured interfaces on the port adapter back to the state they were in when they were removed. Any newly inserted interfaces are put in the administratively shutdown state, as if they were present (but not configured) at boot time. If a similar port adapter type is reinserted into a slot, its ports are configured and brought on line up to the port count of the original port adapter.

Peripheral Component Interconnect Buses

All interfaces connect to two Peripheral Component Interconnect (PCI) buses on the router that provide a path to packet I/O memory and the network processor. Interfaces in slots 1, 3, and 5 use PCI bus 0 and interfaces in slots 0, 2, and 4 use PCI bus 1. For port adapters that are installed in the modular port adapter slots (slot 3 or slot 4), use the guidelines described in Appendix A, “Modular Port Adapter Configuration Guidelines,” to ensure sufficient bandwidth.

The maximum recommended bandwidth points on each PCI bus is 600 points. For best performance we recommend that you avoid using port adapters that exceed the total available bandwidth for your router.

Network Processor Card

The network processor card resides inside the chassis and is shown in Figure 1-33. The network processor card provides the following features:

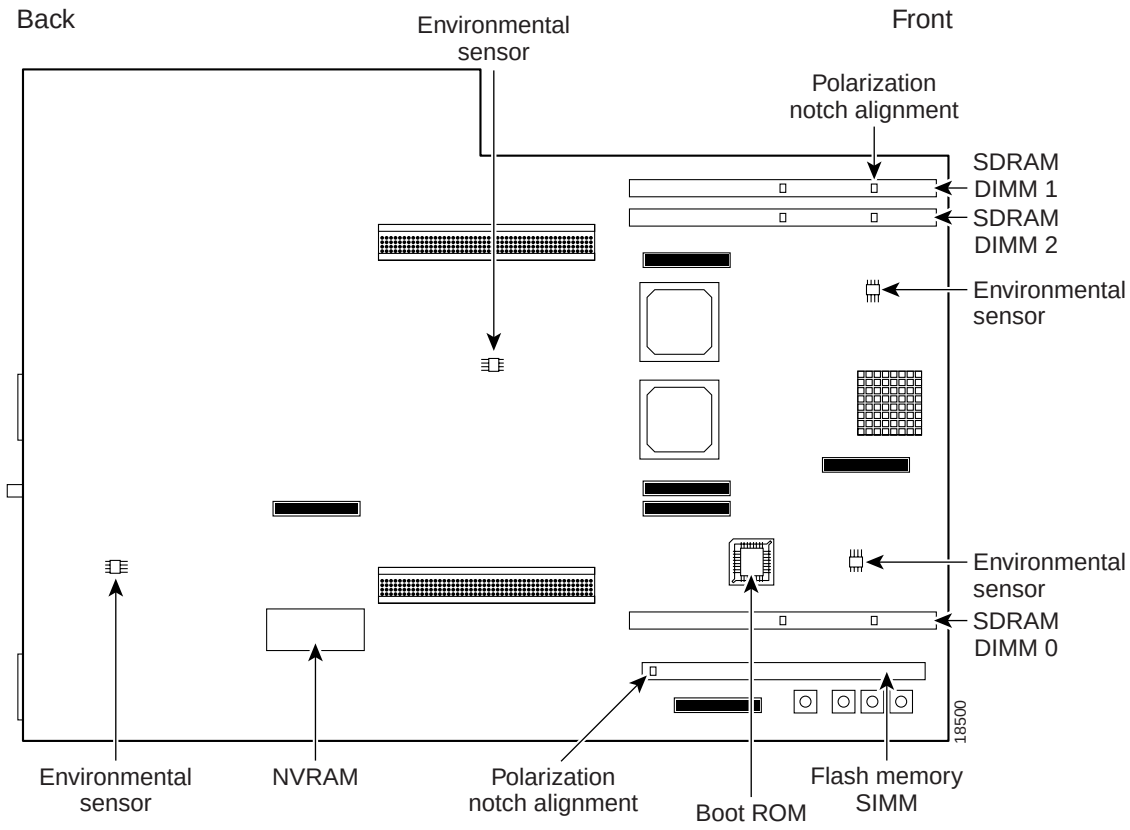
- Senses OIR of the port adapters
- Bridges the PCI buses from the interfaces to packet memory
- Arbitrates traffic across the PCI buses
- Generates the clock signals for the interfaces on each PCI bus

The network processor card also performs the following system management functions:

- Sending and receiving routing protocol updates
- Managing tables, caches, and buffers
- Monitoring interface and environmental status
- Providing Simple Network Management Protocol (SNMP) management and the console or Telnet interface
- Accounting and switching of data traffic
- Booting and reloading images
- Managing port adapters (recognition and initialization during OIR)

Note Instructions for removing and replacing memory components on the network processor card, such as the SDRAM DIMMs, are contained in the *Installing Field-Replaceable Units in Cisco 7100 Series VPN Routers* document available online and on the Documentation CD.

Figure 1-33 Network Processor Card



The network processor card consists of the following components:

- Reduced Instruction Set Computing (RISC) microprocessor
- Two system controllers—Provide processor access to two separate banks of SDRAM and that permit devices on both PCI buses to access either SDRAM bank. This means that devices on different PCI buses can access different SDRAM banks simultaneously.
- Upgradable memory modules—SDRAM system memory is up to 256 MB. (SDRAM packet memory is fixed at 64 MB.) SDRAM memory stores packets received or sent from network interfaces, routing tables, and network accounting applications. There are two independent SDRAM memory arrays that allow concurrent access by interfaces and the processor.

Note The network processor card contains two SDRAM slots for user-configurable system and packet memory, DIMM 1 and DIMM 2. The amount of memory installed in slot DIMM 1 must be greater than or equal to the amount of memory installed in slot DIMM 2, and slot DIMM 2 can be zero.

Slot DIMM 0 is used exclusively for packet memory and is fixed at 64 MB in the factory.

- Cache memory
  - Cisco 7120 series routers have two levels of cache: a primary cache that is internal to the microprocessor and a secondary, 2-MB (fixed) external cache that provides additional high-speed storage for data and instructions.

  - Cisco 7140 series routers have three levels of cache: a primary and a secondary cache that are internal to the microprocessor and a tertiary, 2-MB (fixed) external cache that provides additional high-speed storage for data and instructions.

- Four environmental sensors—Monitor the cooling air as it leaves the chassis.
- Boot ROM—Stores sufficient code for booting the Cisco IOS software.
- Flash memory single in-line memory module (SIMM)—Stores the boot image used to boot the router.
- NVRAM—Stores the system configuration and environmental monitoring logs (the NVRAM uses lithium batteries to maintain its contents when disconnected from power).
- Console port—Provides access for a local terminal and is equipped with an RJ-45 receptacle.
- Auxiliary port—Provides access for a modem for remote access and is equipped with an RJ-45 receptacle.
- Two fixed LAN ports—Provide 10BaseT/100BaseTX autosensing Ethernet/Fast Ethernet (full and half duplex) and are equipped with an RJ-45 receptacle.
- Two PC Card slots—Contain Flash Disks or Flash memory cards that provide the default Cisco IOS software image.

Table 1-15 describes the memory types on the network processor card.

Table 1-15 Network Processor Memory Components

Memory Type	Size	Quantity	Description	Location
SDRAM memory	64 to 128 MB	2 configurable[1] SDRAM slots	64–128-MB DIMMs (based on maximum SDRAM required)	DIMM 1 = U13 DIMM 2 = U14
Boot ROM	512 KB	1	OTP[2] ROM for the ROM monitor program	Socket U21

Table 1-15 Network Processor Memory Components (continued)

Memory Type	Size	Quantity	Description	Location
Primary cache				
Cisco 7120	32 KB (instruction), 32 KB (data)	–	Processor's primary internal cache	Internal to processor
Cisco 7140	16 KB (instruction), 16 KB (data)	–	Processor's primary internal cache	Internal to processor
Secondary cache[3]	256 KB	–	Processor's secondary unified instruction and data cache	Internal to Cisco 7140 processors only
External cache	2 MB (fixed)	–	Secondary external cache for Cisco 7120 series processors Tertiary external cache for Cisco 7140 series processors	–
Flash memory SIMM	8 MB	1	Contains the default boot helper image	Flash SIMM socket P2
Flash Disk	48 MB and 128 MB	Up to 2	Contains the default Cisco IOS image	PC Card slot 0 and slot 1
NVRAM	128 KB	1	Nonvolatile EPROM for the system configuration file	U69

1. Slot DIMM 0 (U16) is used exclusively for packet memory and is not user-configurable.
2. OTP = one-time programmable.
3. Cisco 7120 series routers do not have a secondary internal cache.

To identify the processor and software version installed in your Cisco 7100 series VPN router, use the **show version** command. The following example using a Cisco 7120 series router shows sample output from the **show version** command:

```
Router# show version
Cisco Internetwork Operating System Software
IOS (tm) EGR Software (c7100-P-M), Released Version 12.0(4)XE
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Mon 07-Jun-99 17:49 by biff
Image text-base:0x600088F8, data-base:0x60A54000

ROM:System Bootstrap, Version 12.0(4)XE, RELEASED SOFTWARE
BOOTFLASH:EGR Software (c7100-BOOT-M), Released Version 12.0(4)XE

Router uptime is 19 minutes
System restarted by reload
System image file is "c7100-p-mz"

cisco 7120-T3 (EGR) processor with 61440K/69632K bytes of memory.
R527x CPU at 225Mhz, Implementation 40, Rev 10.0, 2048KB L2 Cache
Last reset from power-on
X.25 software, Version 3.0.0.
```

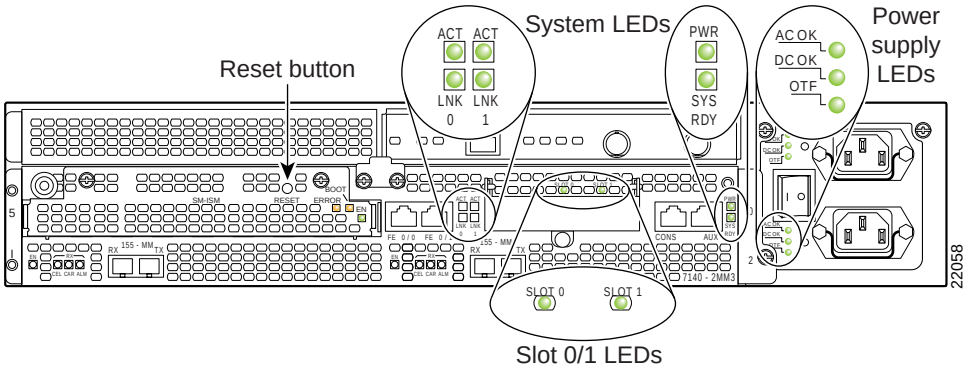
```
3 FastEthernet/IEEE 802.3 interface(s)
1 Serial network interface(s)
125K bytes of non-volatile configuration memory.

4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2000
```

System LEDs and Reset Button

Cisco 7100 series VPN routers provide LEDs to indicate the status of the router and a CPU reset button that allows you to reset the entire system. The LEDs are shown in Figure 1-34 and described in Table 1-16.

Caution To prevent system errors and problems, use the CPU reset button only at the direction of your service representative.

Figure 1-34 Cisco 7100 Series System LEDs



Note The Cisco 7100 series system LEDs are identical for all models except that Cisco 7120 series routers have no power supply LEDs, while Cisco 7140 series routers have two identical banks of three LEDs that correspond to each AC-input receptacle.

Table 1-16 Cisco 7100 Series System LED Descriptions

LED Label	Color	State	Function
ACT 0 ACT 1	Green	On	Indicates 10BaseT/100BaseTX Ethernet ports are transmitting or receiving packets (activity).
LNK 0 LNK 1	Green	On	Indicates 10BaseT/100BaseTX Ethernet ports have established a valid link with the network. This LED remains off during normal operation of the router, unless there is an incoming carrier signal.
SLOT 0 SLOT 1	Green	On	Indicates which PC Card slot is in use when either slot is being accessed by the system. These LEDs remain off during normal operation of the router.

Table 1-16 Cisco 7100 Series System LED Descriptions (continued)

LED Label	Color	State	Function
PWR	Green	On	Indicates that the power supply is delivering AC-input power to the router.
SYS RDY	Green	On	Indicates the system is operational.
AC OK	Green	On	Indicates that AC input is within normal range.
DC OK	Green	On	Indicates that DC output is within normal range.
OTF	Green	On	Indicates that internal temperatures are normal.
	Amber	On	Indicates a power supply fan failure.

Environmental Monitoring and Reporting Functions

Environmental monitoring and reporting functions are controlled by the network processor and allow you to maintain normal system operation by identifying and resolving adverse conditions that might disrupt operation.

The environmental monitoring functions constantly monitor the internal chassis air temperature and power supply voltages and currents. The power supply monitors its own voltage and temperature and shuts itself down if it detects a critical condition within the power supply. The reporting functions periodically log the values of measured parameters so that you can retrieve them for analysis later, and the reporting functions display warnings on the console if any of the monitored parameters exceed defined thresholds.

The front and back of the chassis must remain unobstructed to ensure adequate airflow and prevent overheating inside the chassis; we recommend at least 3 inches (7.6 cm) of clearance. Temperature sensors in the router monitor the internal air temperature and send warning messages when the internal air temperature exceeds the specified threshold.

Environmental Monitoring

The environmental monitoring functions use four sensors to monitor the temperature of the cooling air as it moves through the chassis.

If the air temperature exceeds a defined threshold, the router displays warning messages on the console terminal. The system stores the present parameter measurements for both temperature and power voltage in NVRAM so you can retrieve them later.

In addition, the power supply monitors the internal power supply temperature and voltages. A power supply is either within tolerance (normal) or out of tolerance (critical). If the internal power supply temperature or voltage reaches a critical level, the power supply shuts down without any interaction with the system processor.

The environmental monitoring functions use the following levels of status conditions to monitor the system:

- Normal—All monitored parameters are within normal tolerances.
- Warning—The system has exceeded a specified threshold. The system continues to operate, but operator action is recommended to bring the system back to a normal state.
- Critical—An out-of-tolerance temperature or voltage condition exists. The system continues to operate; however, immediate operator action is required.

Note For more information on troubleshooting an overtemperature condition in your router, see the "Troubleshooting the Cooling Subsystem" section on page 5-6.

Table 1-17 lists the typical temperature thresholds for each network processor type, and Table 1-18 lists the power thresholds for the normal, warning, and critical (power supply-monitored) levels.

Table 1-17 Typical Processor-Monitored Temperature Thresholds

Parameter	High Warning	High Critical
Core	120°F (49°C)	129°F (54°C)
Chassis inlet	109°F (43°C)	118°F (48°C)
Chassis outlet 1	114°F (46°C)	123°F (51°C)
Chassis outlet 2	116°F (47°C)	125°F (52°C)

Note If the system reports temperatures in the critical range, you must manually shut down the router. The processor cannot shut down the router automatically.

Table 1-18 Typical Power Supply-Monitored Voltage Thresholds

Parameter	Low Critical	Low Warning	High Warning	High Critical
+2.5V	+2.35V	+2.39V	+2.69V	+2.72V
+3.3V	+3.11V	+3.19V	+3.39V	+3.47V
+5.15V	+4.88	+5.00	+5.23	+5.39
+12.3V	+11.53	+11.77	+12.76	+13.05
+12.3V	+11.53	+11.77	+12.76	+13.05
–12.5V	–10.20V	–11.24V	–13.71V	–14.33V

Displaying Environmental Status Reports

Cisco 7100 series VPN routers display warning messages on the console if chassis interface-monitored parameters exceed a desired threshold. You can also retrieve and display environmental status reports with the **show environment**, **show environment all**, **show environment last**, and **show environment table** commands. Parameters are measured and reporting functions are updated every 60 seconds. A brief description of each of these commands follows.

Caution To prevent overheating the chassis, ensure that your system is drawing cool inlet air. Overtemperature conditions can occur if the system is drawing in the exhaust air of other equipment. Ensure adequate clearance around the sides of the chassis so that cooling air can flow through the chassis interior unimpeded and exhaust air exits the chassis and is not drawn into the inlet vent of other device.

The **show environment** command displays the current environmental status of the system. The report displays parameters that are out of the normal values. No parameters are displayed if the system status is normal. The example that follows shows the display for a system in which all monitored parameters are within normal range:

```
Router# show environment
All measured values are normal
```

If the environmental status is *not* normal, the system reports the worst-case status level. Following is a sample overvoltage warning:

```
Router# show environment
Warning: +3.3 V measured at +3.41 V
```

The **show environment last** command retrieves and displays the NVRAM log, which provides a record of environmental status readings. Air temperature is measured and displayed, and the voltage supplied by the power supply is also displayed.

Following is sample output of the **show environment last** command:

```
Router# show environment last
  chassis corepreviously measured at 34C/93F
  chassis inletpreviously measured at 28C/82F
  chassis outlet 1previously measured at 31C/87F
  chassis outlet 2previously measured at 33C/91F
  +2.5 Vpreviously measured at +2.59
  +3.3 Vpreviously measured at +3.32
  +5.15 Vpreviously measured at +5.13
  +12.3 Vpreviously measured at +12.99
  +12.3 Vpreviously measured at +12.33
  -12.5 Vpreviously measured at -12.43
```

The **show environment table** command displays the temperature and voltage thresholds for each temperature sensor and for each monitored status level, which are related to those thresholds listed in Table 1-17 and Table 1-18.

Following is sample output of the **show environment table** command:

```
Router# show environment table
Sample Point       LowCritical       LowWarning       HighWarning       HighCritical
chassis core                                          49C/120F          54C/129F
chassis inlet                                         43C/109F          48C/118F
chassis outlet 1                                      46C/114F          51C/123F
chassis outlet 2                                      47C/116F          52C/125F
+2.5 V             +2.35             +2.39            +2.69             +2.72
+3.3 V             +3.11             +3.19            +3.39             +3.47
+5.15 V            +4.88             +5.00            +5.23             +5.39
+12.3 V            +11.53            +11.77           +12.76            +13.05
+12.3 V            +11.53            +11.77           +12.76            +13.05
-12.5 V            -10.20            -11.24           -13.71            -14.33
```

Note Temperature ranges and values are subject to change.

The **show environment all** command displays an extended report that includes temperature readings and voltage readings.

Following is sample output of the **show environment all** command:

```
Router# show environment all
```

```
Power Supply:
        Power supply is standard power supply. Unit is on.

Temperature readings:
        chassis core     measured at 33C/91F
        chassis inlet    measured at 27C/80F
        chassis outlet 1 measured at 30C/86F
        chassis outlet 2 measured at 32C/89F

Voltage readings:
        +2.5 V  measured at +2.59 V
        +3.3 V  measured at +3.32 V
        +5.15 V measured at +5.13 V
        +12.3 V measured at +12.29 V
        +12.3 V measured at +12.33 V
        -12.5 V measured at -12.43 V

Envm stats saved 2 time(s) since reload
```

Fan Failures

When the system power is on, all four fans should be operational. The system continues to operate if a fan fails; however, if the air temperature exceeds a defined threshold, the router displays warning messages on the console terminal. (See the "Troubleshooting the Cooling Subsystem" section on page 5-6.)

For complete descriptions and instructions of the environmental monitor commands, refer to the *Configuration Fundamentals Configuration Guide* and *Configuration Fundamentals Command Reference* publications, available online and on the Documentation CD.

Preparing for Installation

This chapter describes the tasks you must perform before you begin to install a Cisco 7100 series VPN router and includes the following sections:

- Tools and Parts Required, page 2-1
- Shipping Container Contents, page 2-2
- Safety Guidelines, page 2-2

Warning **Only trained and qualified personnel should be allowed to install, replace, or service this equipment. This equipment contains an energy hazard. Disconnect the system before servicing.**

Read the installation instructions before you connect the system to its power source.

Tools and Parts Required

Cisco 7100 series routers are fully assembled at the factory; no additional assembly is required prior to installing the router. The following tools and parts are shipped with Cisco 7100 series routers (unless noted otherwise) and are required for installation:

- Electrostatic discharge (ESD)-preventive wrist strap
- Number 2 Phillips screwdriver (not included with the router)
- Flat-head screwdriver (not included with the router)
- Rack-mount and cable-management kit for 19- or 23-inch, four-post or telco-type rack installation
- Rubber feet for desktop installation
- One double ground lug and two M3.5 x 8-mm screws for grounding the chassis

Shipping Container Contents

Ensure that the correct Cisco 7100 series router is in the shipping container. The shipping container includes the following items:

- Cisco 7100 series router with appropriate port adapter card installed
- A rack-mount and cable-management kit that includes the following items:
  - Two rack-mount brackets for 19-inch rack installations
  - Two rack-mount brackets for 23-inch rack installations
  - One cable-management bracket
  - Sixteen M3.5 x 8-mm Phillips flathead screws for securing the rack-mount brackets to the chassis
  - Two M3.5 x 7-mm slotted hexhead screws for securing the cable-management bracket to the chassis

Note Four 10-32 x 3/8-inch slotted binderhead screws are required to secure the chassis to the rack rails; the binderhead screws are not included in the rack-mount and cable-management kit.

- ESD-preventive wrist strap
- Nylon cable tie
- Cable tie holder
- Ground lug kit that includes two M3.5 x 7-mm screws
- Documentation CD-ROM
- Documentation
  - *Cisco 7100 Series VPN Router Documentation* flyer
  - *Cisco 7100 Series VPN Router Regulatory Compliance and Safety Information*
  - A Cisco IOS release note for the software installed on the router

Keep the shipping container in case you must return the router to the factory.

Safety Guidelines

Any device that uses electricity must be handled carefully; follow these guidelines to ensure general safety:

- Keep the chassis area clear and dust-free during and after installation.
- Put the removed chassis cover in a safe place.

Warning **The safety cover is an integral part of the product. Do not operate the unit without the safety cover installed. Operating the unit without the cover in place will invalidate the safety approvals and pose a risk of fire and electrical hazards.**

- Keep tools away from walk areas where you and others could fall over them.

- Do not wear loose clothing, jewelry (including rings and chains), or other items that could get caught in the chassis. Fasten your tie or scarf and roll up your sleeves.
- Wear safety glasses if you are working under any conditions that might be hazardous to your eyes.
- Do not perform any action that creates a potential hazard to people or makes the equipment unsafe.
- The installation of the router should be in compliance with national and local electrical codes. In the United States, National Fire Protection Association (NFPA) 70, United States National Electrical Code. In Canada, Canadian Electrical Code, part I, CC22.1. In other countries, International Electrotechnical Commission (IEC) 364, part 1 through part 7.
- Never attempt to lift an object that might be too heavy for you to lift by yourself.
- Always turn all power supplies off (O) and unplug all power cables before opening the chassis.
- Always unplug the power cable before installing or removing a chassis.
- The AC-powered routers ship with a three-wire electrical grounding-type plug, which only fits into a grounding-type power outlet. This is a safety feature. The equipment grounding should be in accordance with local and national electrical codes.
- The routers operate safely when used in accordance with their marked electrical ratings and product usage instructions.

Warning **Ultimate disposal of this product should be handled according to all national laws and regulations.**

Electrical Equipment Guidelines

Warning **Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is off and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected.**

Warning **Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or can weld the metal object to the terminals.**

Warning **This unit might have more than one power supply connection. All connections need to be removed to de-energize the unit.**

Follow these guidelines when you work on equipment powered by electricity.

- Locate the emergency power-off switch for the room in which you are working. Then, if an electrical accident occurs, you can act quickly to turn off the power.
- Before working on the system, unplug the power cord.
- Disconnect all power before doing the following:
  - Installing or removing a chassis
  - Working near power supplies

Warning **This equipment is intended to be grounded. Ensure that the host is connected to earth ground during normal use.**

Warning **When installing the unit, the ground connection must always be made first and disconnected last.**

- Do not work alone if potentially hazardous conditions exist.
- Never assume that power is disconnected from a circuit. Always check.
- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, frayed power cords, and missing safety grounds.
- If an electrical accident occurs, proceed as follows:
  - Use caution; do not become a victim yourself.
  - Turn off power to the system.
  - If possible, send another person to get medical aid. Otherwise, assess the condition of the victim and then call for help.
  - Determine if the person needs rescue breathing or external cardiac compressions; then take appropriate action.

Warning **This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a fuse or circuit breaker no larger than 120 VAC, 15A U.S. (240 VAC, 10A international) is used on the phase conductors (all current-carrying conductors).**

In addition, use the guidelines that follow when working with any equipment that is disconnected from a power source, but still connected to telephone wiring or other network cabling.

- Never install telephone wiring during a lightning storm.
- Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.
- Use caution when installing or modifying telephone lines.

Warning **To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.**

Electrostatic Discharge Prevention

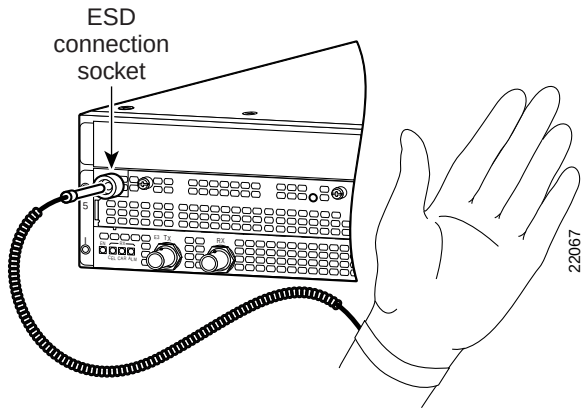
Electrostatic discharge (ESD) can damage equipment and impair electrical circuitry. ESD damage occurs when electronic components are improperly handled and can result in complete or intermittent failures. Figure 2-1 illustrates how to attach an electrostatic discharge wrist strap.

Always follow ESD-prevention procedures when you remove and replace components. Ensure that the chassis is electrically connected to earth ground. Wear an ESD-preventive wrist strap, ensuring that it makes good skin contact. Connect the grounding clip to an unpainted surface of the chassis frame to

safely ground unwanted ESD voltages. To guard against ESD damage and shocks, the wrist strap and cord must operate properly. If no wrist strap is available, ground yourself by touching the metal part of the chassis.

Caution For safety, periodically check the resistance value of the antistatic strap, which should be between 1 and 10 megohms (Mohm).

Figure 2-1 Attaching an Electrostatic Discharge Wrist Strap



Chassis Lifting Guidelines

A fully configured Cisco 7100 series router weighs approximately 32 pounds (14.5 kg). The chassis is not intended to be moved frequently. Before you install the router, ensure that your site is properly prepared so you can avoid having to move the chassis later to accommodate power sources and network connections.

Whenever you lift the chassis or any heavy object, follow these guidelines:

- Always disconnect all external cables before lifting or moving the chassis.
- Ensure that your footing is solid, and balance the weight of the object between your feet.
- Lift the chassis slowly; never move suddenly or twist your body as you lift.
- Keep your back straight and lift with your legs, not your back. If you must bend down to lift the chassis, bend at the knees, not at the waist, to reduce the strain on your lower back muscles.
- Lift the chassis from the bottom; grasp the underside of the chassis exterior with both hands.

Warning **To prevent personal injury or damage to the chassis, never attempt to lift or tilt the chassis using the handles on the port adapters; these types of handles are not designed to support the weight of the unit. Lift the unit only by grasping the chassis underneath its lower edge.**

Site Requirement Guidelines

Warning **This unit is intended for installation in restricted access areas. A restricted access area is where access can only be gained by service personnel through the use of a special tool, lock and key, or other means of security, and is controlled by the authority responsible for the location.**

The environmental monitoring functionality in the router protects the system and components from potential damage from overvoltage and overtemperature conditions. To ensure normal operation and avoid unnecessary maintenance, plan your site configuration and prepare your site *before* installation. After installation, make sure the site maintains an ambient temperature of 32°F through 104°F (0°C through 40°C), and keep the area around the chassis as free from dust as is practical.

Planning a proper location for the router and the layout of your equipment rack or wiring closet is essential for successful system operation. Equipment placed too close together or inadequately ventilated can cause system overtemperature conditions. In addition, chassis panels made inaccessible by poor equipment placement can make system maintenance difficult. Following are precautions that can help avoid problems during installation and ongoing operation.

Follow these general precautions when planning your equipment locations and connections:

- Plan for access to both front and rear panels of the chassis.
- Ensure that the room where the chassis operates has adequate ventilation. Remember that electrical equipment generates heat. Ambient air temperature may not cool equipment to acceptable operating temperatures without adequate ventilation.
- Use the **show environment** command regularly to check the internal system status. The environmental monitor continually checks the interior chassis environment; it provides warnings for high temperature and maximum and minimum voltages and creates reports on any occurrences. If warning messages are displayed, take immediate action to identify the cause and correct the problem.
- We recommend keeping the router off the floor and out of any area that tends to collect dust.
- Follow ESD prevention procedures to avoid damage to equipment. Damage from static discharge can cause immediate or intermittent equipment failure.
- Ensure that port adapters and any blank port adapters are in place and secure. The fans direct cooling air throughout the chassis interior; a loose component or empty slot can redirect the air flow away from active components.

Rack-Mounting Guidelines

The rack-mounting hardware included with router is suitable for most 19- or 23-inch equipment racks and telco-type racks. To easily access the interface cables while the router is installed in a rack, make certain you have access to the rear of the router.

Before using a particular rack, check for obstructions (such as a power strip) that could impair rack-mount installation. If a power strip does impair a rear rack-mount installation, remove the power strip before installing the router in the rack, and then replace it after the chassis is installed. As an alternative, you can mount the router on an equipment shelf provided that the rack dimensions allow you to secure the router to the shelf, and the overall configuration permits safe installation and access. However, we recommend rack-mounting the router. Figure 2-2 shows the Cisco 7100 series router footprint and outer dimensions.

To use the rack-mounting hardware provided with the router, consider the following guidelines:

- To mount the router between two posts or rails using the brackets, the inner clearance (the width between the *inner* sides of the two posts or rails) must be at least 17 inches (43.18 cm).
- The height of the chassis is 3.5 inches (8.89 cm).
- When mounting the router in four-post or telco-type racks, be sure to use all the screws and the brackets provided to secure the chassis to the rack posts.
- If you plan to use an equipment shelf, ensure that the shelf is constructed to support the weight and dimensions of the chassis. Figure 2-2 shows the chassis footprint, which you need if you are designing a customized shelf. We recommend that you use the rack-mount kit designed for Cisco 7100 series routers.

When planning your rack installation, consider the following guidelines:

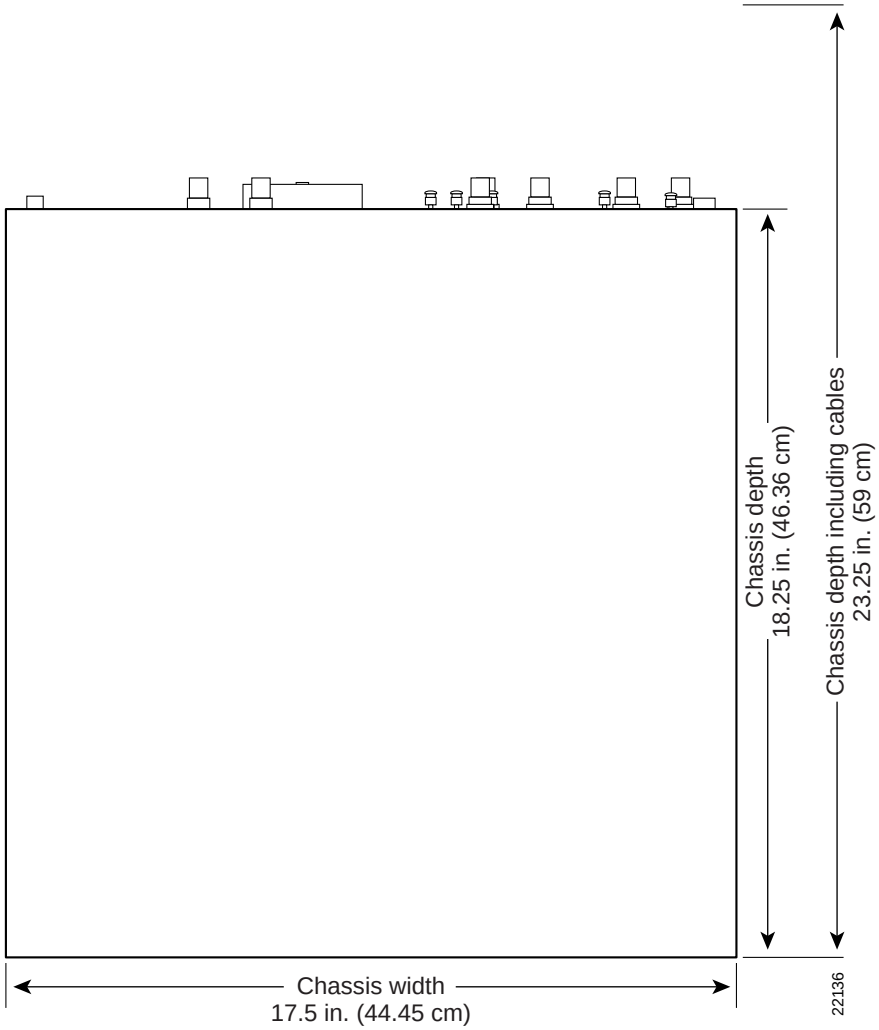
- Install the router in an open rack whenever possible. If installation in an enclosed rack is unavoidable, ensure that the rack has adequate ventilation.

  An enclosed rack should have louvered sides and a fan to provide cooling air because heat generated by equipment near the bottom of the rack can be drawn upward into the intake ports of the equipment above.

Caution To prevent chassis overheating, never install the router in an enclosed rack or room that is not properly ventilated or air conditioned.

- Ensure that the rack is not congested, because each unit generates heat. Maintain a minimum clearance of 3 inches (7.62 cm) on the back and front of the chassis for the cooling air inlet and exhaust ports, respectively.
- Baffles can isolate exhaust air from intake air, which also helps to draw cooling air through the chassis. The best placement of the baffles depends on the airflow patterns in the rack, which can be found by experimenting with different configurations.
- When equipment installed in a rack (particularly in an enclosed rack) fails, try operating the equipment by itself, if possible. Power off other equipment in the rack to allow the unit under test a maximum of cooling air and clean power.
- Allow sufficient clearance around the rack for maintenance. If the rack is mobile, you can push it back near a wall or cabinet for normal operation and pull it out for maintenance (installing or removing a port adapter or connecting cables). Otherwise, allow 19 inches (48.3 cm) of clearance to remove the port adapter.
- Install the chassis and external devices to which it will connect in a contiguous stack.

Figure 2-2 Cisco 7100 Series Router Footprint and Outer Dimensions



- Always install heavier equipment in the lower half of a rack to maintain a low center of gravity and prevent the rack from falling over.
- If you use telco-type racks, be sure that the rack is bolted to the floor and secured because in these types of installations only one end of the chassis mounts to the two rack posts with the brackets. Ensure that the weight of the chassis does not make the rack unstable.
- Provide an adequate chassis ground (earth) connection for your router chassis.

Note We strongly recommend that you provide a chassis ground connection. (See the "Attaching a System Ground Connection" section on page 3-4 for instructions.)

In addition to the preceding guidelines, review the precautions for avoiding overtemperature conditions in the following section, "Temperature and Humidity Requirements." To properly install a Cisco 7100 series chassis in a rack, see the instructions in the "Rack-Mounting the Chassis" section on page 3-2.

Temperature and Humidity Requirements

Table 2-1 lists the operating and nonoperating environmental site requirements. The ranges listed are those within which Cisco 7100 series routers continue to operate; however, a measurement that is approaching the minimum or maximum of a range indicates a potential problem. You can maintain normal operation by anticipating and correcting environmental anomalies before they approach a maximum operating range.

Table 2-1 Specifications for Operating and Nonoperating Environments

Specification	Minimum	Maximum
Temperature, ambient operating	32°F (0°C)	104°F (40°C)
Temperature, ambient nonoperating and storage	–4°F (–20°C)	149°F (65°C)
Humidity, ambient (noncondensing) operating	10%	90%
Humidity, ambient (noncondensing) nonoperating and storage	5%	95%
Altitude, operating and nonoperating	Sea level	10,000 ft. (3050 m)
Vibration, operating	5–200 Hz, 0.5 g (1 octave/min.)	–

Power Connection Guidelines

Follow these precautions and recommendations when planning power connections to a Cisco 7100 series router:

- Check the power at your site before installation and periodically after installation to ensure that you are receiving clean power. Install a power conditioner if necessary.
- The AC power supply includes the following features:
  - Autoselects either 110V or 220V operation.
  - All units include a 6-foot (1.8-meter) electrical power cord. (A label near the power cord indicates the correct voltage, frequency, current draw, and power dissipation for the unit.)

Warning **This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a fuse or circuit breaker no larger than 120 VAC, 15A U.S. (240 VAC, 10A international) is used on the phase conductors (all current-carrying conductors).**

- For Cisco 7140 series routers, we recommend connecting each power supply to a separate AC power source for maximum redundancy.

Note Cisco 7140 series routers will operate with power connected to either of the two power supplies. The second AC-input power supply simply enables power load-sharing and redundancy. There is no primary or secondary power supply for Cisco 7140 series routers.

- Install proper grounding to avoid damage from lightning and power surges.

Warning **Never defeat the ground conductor or operate the equipment in the absence of a suitably installed ground conductor. Contact the appropriate electrical inspection authority or an electrician if you are uncertain that suitable grounding is available.**

The Cisco 7100 series router installation must comply with all applicable codes and is approved for use with copper conductors only. The ground bond fastening hardware should be of compatible material and preclude loosening, deterioration, and electrochemical corrosion of hardware and joined material. Attachment of the chassis ground to a central office or other interior ground system should be made with a 6-AWG, copper ground conductor at a minimum.

The chassis employs two threaded chassis grounding receptacles, located on the sides near the rear of the chassis, which are intended to be bonded directly to the central offices or other interior ground system. The chassis ground requires M3.5 screws, which are included. (For instructions on how to properly ground the chassis, see the "Attaching a System Ground Connection" section on page 3-4.)

- The AC-input power supply operates on input voltage and frequency within the ranges of 100 to 240 VRMS and 50/60 Hz without the need for operator adjustments. This power supply also incorporates an active power factor corrector that minimizes the unwanted generation of line current harmonics that can cause overload of site electrical distribution systems.

Note We recommend an uninterruptible power source to protect against power failures at your site. We recommend powering a Cisco 7100 series router from a 15A receptacle at the power source.

Plant Wiring Guidelines

Following are guidelines for setting up the plant wiring and cabling at your site. When planning the location of the new system, consider the distance limitations for signaling, EMC, and connector compatibility, as described in the following sections.

Interference Considerations

When wires are run for any significant distance in an electromagnetic field, interference can occur between the field and the signals on the wires. This fact has two implications for the construction of plant wiring:

- Bad wiring practice can result in radio interference emanating from the plant wiring.
- Strong electromagnetic interference (EMI), especially when it is caused by lightning or radio transmitters, can destroy the signal drivers and receivers in the router, and can even create an electrical hazard by conducting power surges through lines and into equipment. (Review the safety warnings in the "Electrical Equipment Guidelines" section on page 2-3.)

Note To predict and remedy strong EMI, you may also need to consult experts in radio frequency interference (RFI).

If you use twisted-pair cable in your plant wiring with a good distribution of grounding conductors, the plant wiring is unlikely to emit radio interference. If you exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

If wires exceed recommended distances, or if wires pass between buildings, give special consideration to the effect of a lightning strike in your vicinity. The electromagnetic pulse caused by lightning or other high-energy phenomena can easily couple enough energy into unshielded conductors to destroy electronic devices. If you have had problems of this sort in the past, you may want to consult experts in electrical surge suppression and shielding.

Distance Limitations and Interface Specifications

The size of your networks and the distances between connections depend on the type of signal, the signal speed, and the transmission media (the type of cabling used to transmit the signals). For example, standard coaxial cable has a greater channel capacity than twisted-pair cabling. The distance and rate limits in the following descriptions are the IEEE recommended maximum speeds and distances for signaling; however, you can usually get good results at speeds and distances far greater than these. For example, the recommended maximum rate for V.35 is 2 Mbps, but it is commonly used at 4 Mbps without any problems. If you understand the electrical problems that might arise and can compensate for them, you should get good results with rates and distances greater than those shown here; however, do so at your own risk.

Note We recommend that you do not exceed specified transmission rate and distance limits.

When preparing your site for network connections to a Cisco 7100 series router, you must consider a number of factors related to each type of interface:

- The type of cabling required for each type (fiber, thick or thin coaxial, foil-twisted pair [FTP], or unshielded twisted-pair [UTP] cabling)
- Distance limitations for each signal type
- The specific cables you need to connect each interface
- Any additional interface equipment you need, such as transceivers, hubs, switches, modems, channel service units (CSUs), or data service units (DSUs)
- Cable pinouts if you plan to build your cables

Note Detailed port adapter installation information is contained in the installation note for the port adapter. For example, if you plan to replace a four-port Ethernet port adapter in your Cisco 7100 series router, refer to the *PA-4E Ethernet 10BaseT Port Adapter Installation and Configuration* note. The document is available online and on the Documentation CD-ROM.

Also see Appendix C, “Cable Specifications,” for cabling information.

Before installing a Cisco 7100 series router, have all additional external equipment and cables on hand. For ordering information, contact a customer service representative.

Ethernet Connections

There are two 10BaseT/100BaseTX Fast Ethernet ports on the rear panel of the router. Both ports use unshielded twisted-pair (UTP) cable. We recommend Category 5 UTP cable. The maximum segment distance is 328 feet (100 meters). UTP cables look like the cables used for ordinary telephones; however, UTP cables meet certain electrical standards that telephone cables do not. Cables are not included.

WAN Connections

Cisco 7100 series routers support a wide range of WAN ports on the rear panel of the router. For more information on the cables used with the WAN ports, see Appendix C, "Cable Specifications."

Warning **This equipment must be installed and maintained by service personnel as defined by AS/NZS 3260. Incorrectly connecting this equipment to a general purpose outlet could be hazardous. The telecommunications lines must be disconnected 1) before unplugging the main power connector and/or 2) while the housing is open.**

Warning **Incorrect connection of this or connected equipment to the general purpose outlet could result in a hazardous situation.**

Warning **Hazardous network voltages are present in WAN ports regardless of whether power to the unit is OFF or ON. To avoid electric shock, use caution when working near WAN ports. When detaching cables, detach the end away from the unit first.**

Laser and LED Safety Guidelines

The single-mode transmitter in the ATM port uses a small laser to transmit the light signal to the network ring. Keep the transmit port covered whenever a cable is not connected to it. Although multimode transceivers typically use LEDs for transmission, it is good practice to keep open ports covered and avoid staring into open ports or apertures.

The Cisco 7120-SMI and Cisco 7140-MM3 ATM port contains a Class 1 laser warning label.

Warning **Class 1 laser product.**

Warning **Because invisible laser radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to laser radiation and do not stare into open apertures.**

Console and Auxiliary Port Considerations

Cisco 7100 series routers include an asynchronous serial console and auxiliary port. The console and auxiliary ports provide access to the access server either locally (with a console terminal) or remotely (with a modem). This section discusses important cabling information to consider before connecting a console terminal (an ASCII terminal or PC running terminal emulation software) to the console port or modem to the auxiliary port.

The main difference between the console and auxiliary ports is that the auxiliary port supports hardware (Request To Send [RTS])/Clear To Send [CTS]) flow control and the console port does not. Flow control paces the transmission of data between a sending device and a receiving device. Flow control ensures that the receiving device can absorb the data sent to it before the sending device sends more.

When the buffers on the receiving device are full, a message is sent to the sending device to suspend transmission until the data in the buffers has been processed. Because the auxiliary port supports flow control, it is ideally suited for use with the high-speed transmissions of a modem. Console terminals transmit at slower speeds than modems; therefore, the console port is ideally suited for use with console terminals.

For detailed information about installing a console terminal and connecting devices to the auxiliary port, see the "Connecting the Console Port and Auxiliary Port" section on page 3-16. For cable and port pinouts, see Appendix C, "Cable Specifications."

Console Port Connections

Cisco 7100 series routers include an EIA/TIA-232 asynchronous serial console port (RJ-45). Depending on the cable and the adapter used, this port will appear as a data terminal equipment (DTE) or data communications equipment (DCE) device at the end of the cable. Your router arrives with cables and adapters to connect a console terminal (an ASCII terminal or PC running terminal emulation software) to the console port. To connect an ASCII terminal to the console port, use the RJ-45 rollover cable with the female RJ-45-to-DB-25 adapter (labeled TERMINAL).

To connect a PC running terminal emulation software to the console port, use the RJ-45 rollover cable with the female RJ-45-to-DB-9 adapter (labeled TERMINAL). The default parameters for the console port are 9600 baud, 8 data bits, no parity, and 2 stop bits. The console port does not support hardware flow control.

Auxiliary Port Connections

Cisco 7100 series routers include an EIA/TIA-232 asynchronous serial auxiliary port (RJ-45) that supports flow control. Depending on the cable and the adapter used, this port will appear as a DTE or DCE device at the end of the cable. Your router arrives with a cable and an adapter to connect a modem to the auxiliary port. To connect a modem to the auxiliary port, use the RJ-45 rollover cable with the male RJ-45-to-DB-25 adapter (labeled MODEM).

Installing a Cisco 7100 VPN Series Router

This chapter explains how to install a Cisco 7100 series router. Before performing any of the procedures in this chapter, review Chapter 2, "Preparing for Installation," to ensure you understand all the tools required and safety guidelines. This chapter includes the following sections:

- Setting the Chassis on a Tabletop, page 3-1
- Rack-Mounting the Chassis, page 3-2
- Attaching a System Ground Connection, page 3-4
- Connecting to the Network, page 3-7
- Connecting to the Network, page 3-7
- Connecting the Console Port and Auxiliary Port, page 3-16
- Connecting the Power, page 3-18

Warning **Read the installation instructions before you connect the system to its power source.**

Setting the Chassis on a Tabletop

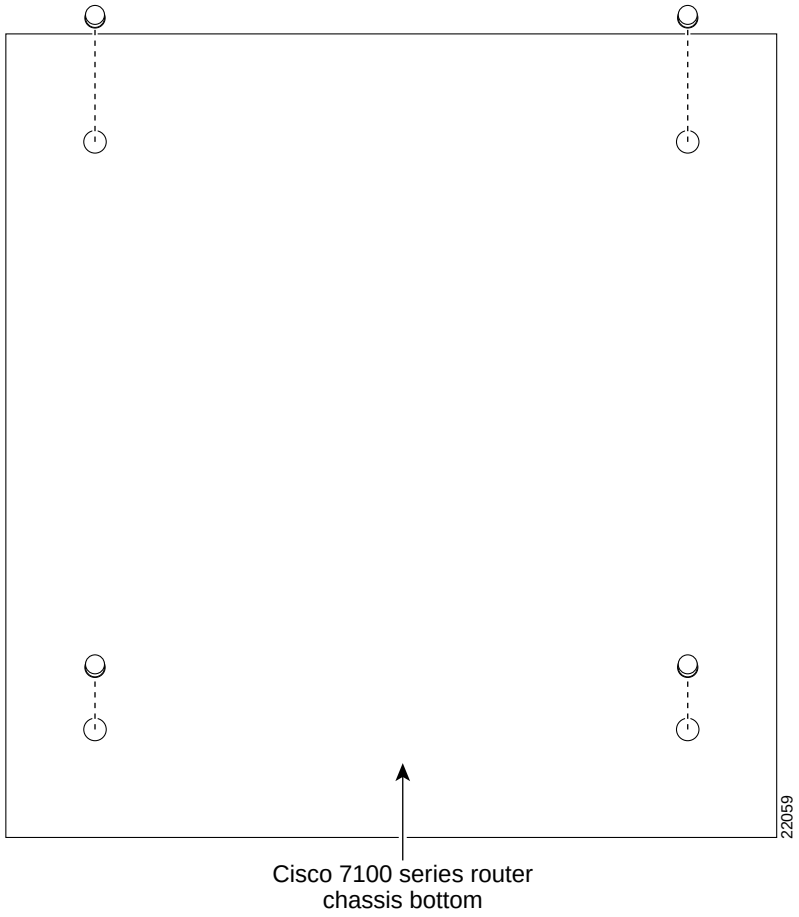
The location of the chassis should be placed to avoid inadequate ventilation; inaccessible panels can cause malfunctions and shutdowns, and can make maintenance difficult.

Note For help planning the location of your chassis, see the "Site Requirement Guidelines" section on page 2-6.

We strongly recommend that you provide a chassis ground connection. See the "Attaching a System Ground Connection" section on page 3-4 for instructions.

Attach the rubber feet as shown in Figure 3-1. Rubber feet are included in the accessory kit that shipped with your router.For help planning the location of your chassis, see the "Site Requirement Guidelines" section on page 2-6.

Figure 3-1 Attaching the Rubber Feet



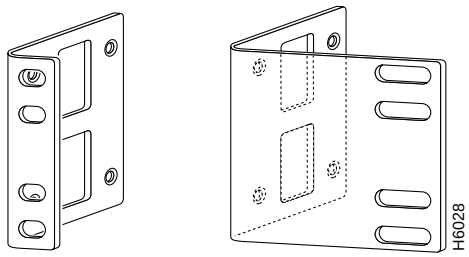
This completes the general tabletop or workbench installation.

Rack-Mounting the Chassis

This section describes how to rack-mount the chassis in a standard four-post equipment rack. The router arrives with 19-inch rack-mount brackets and larger brackets for use with a 23- or 24-inch rack. (See Figure 3-2.)

Note For help planning your equipment rack configuration, see the "Rack-Mounting Guidelines" section on page 2-6.

Figure 3-2 Standard Rack-Mount Brackets



Bracket for 19-inch rack Bracket for 23- or 24-inch rack

Attaching the Brackets

To install the chassis in a rack, attach the brackets in one of the following ways:

- Front panel forward (see Figure 3-3)
- Back panel forward (see Figure 3-4)

Note Although the installations show the 19-inch brackets, the procedure is the same for the 24-inch brackets.

Figure 3-3 Standard Bracket Installation—Front Panel Forward

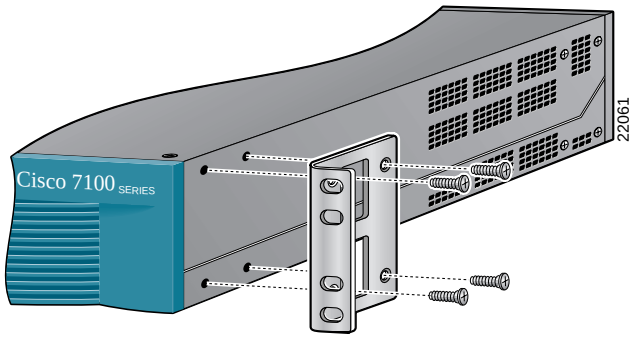
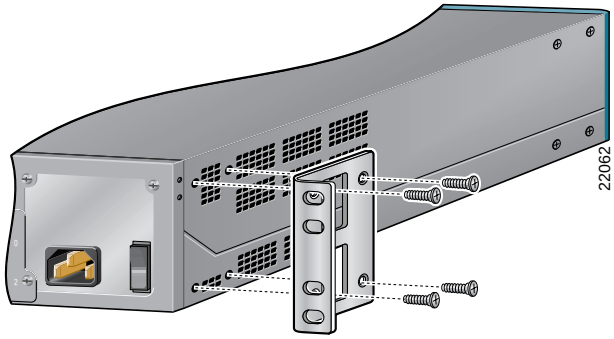


Figure 3-4 Standard Bracket Installation—Back Panel Forward

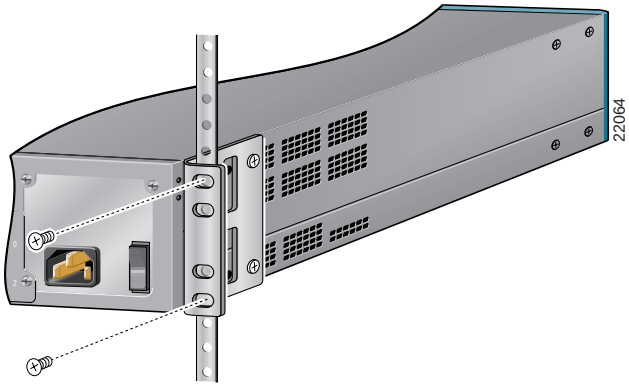


Installing the Chassis in a Rack

After the brackets are secured to the chassis, you can rack-mount the router. Using the screws that you provide, attach the chassis to the rack as shown in Figure 3-5. You need two people to install the chassis in the rack—one person to hold the router and one person to secure it to the rack.

If you rack-mount the router with the back panel forward, you might need to attach the system ground connection before you rack-mount the router. For instructions on how to connect the system ground, see the next section, "Attaching a System Ground Connection."

Figure 3-5 Attaching the Chassis to the Rack—Back Panel Forward



Note: The second bracket attaches to the other side of the chassis.
The brackets can also be installed with the front panel forward.

Attaching a System Ground Connection

Before you connect power or turn on power to your router, we strongly recommend that you provide an adequate chassis ground (earth) connection for your router's chassis. Chassis grounding receptacles are provided on each router chassis.

You will need the following parts and tools:

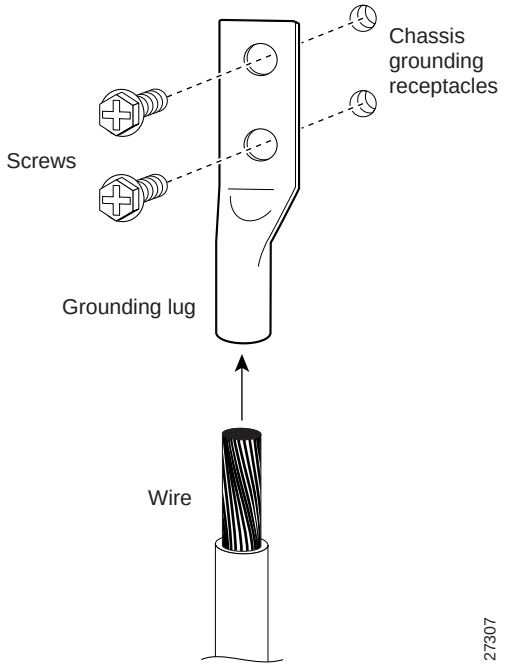
- One grounding lug—Must have two M3.5 screw holes that have a 0.63-inch (16.002-mm) spacing between them, and a wire receptacle large enough to accept a 6-American Wire Gauge (AWG) multistrand, copper wire. This grounding lug is provided in the accessory kit.
- Two slotted hexhead M3.5 x 7-mm thread-forming machine screws. These screws are provided in the accessory kit.
- One grounding wire—6-AWG, 0.162-inch (4.115-mm) diameter, with approximately 0.108 inch (2.743 mm) of insulation, for a total wire diameter of approximately 0.27 inch (6.858 mm). The wire's length is dependent on your router location and site environment. This wire is not available from Cisco Systems; it is available from any commercial cable vendor.
- Flat-blade screwdriver.
- Crimping tool large enough to accommodate the diameter of the wire receptacle on your grounding lug.
- Wire stripper.

To attach the grounding lug to the chassis grounding receptacles, complete the following steps:

Step 1 Strip one end of the 6-AWG wire approximately 0.75 inch (19.05 mm) using the wire stripper.

Step 2 Insert the 6-AWG wire into the wire receptacle on the grounding lug. (See Figure 3-6.)

Figure 3-6 Attaching the Ground Wire to the Grounding Lug

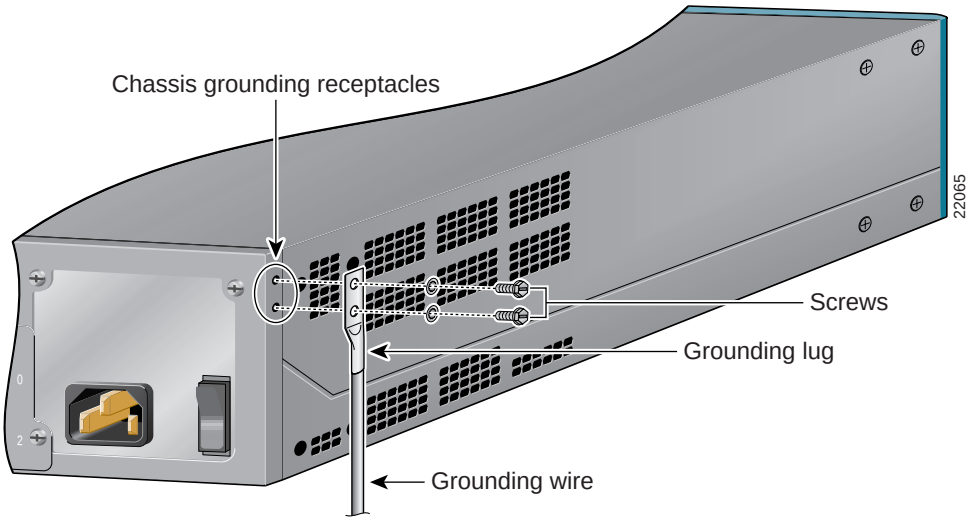


Step 3 Crimp the wire receptacle around the wire using the crimping tool.

Step 4 Insert the two screws through the holes in the grounding lug. (See Figure 3-6.) Ensure that the grounding lug does not interfere with other router hardware.

Step 5 Locate the chassis grounding receptacles on your router chassis. (See Figure 3-7.)

Figure 3-7 Attaching the Grounding Lug to the Chassis Grounding Receptacles



Step 6 Tighten the grounding lug screws using the flat-blade screwdriver. Do not overtighten the screws.

Step 7 Connect the opposite end of the grounding wire to the appropriate grounding point at your site to ensure adequate chassis ground.

This completes the procedure for attaching a ground connection.

Attaching the Cable-Management Bracket

To install the cable-management bracket on the router, complete the following steps:

Step 1 Locate the chassis grounding receptacles on the rear sides of the chassis. Both rear sides of Cisco 7100 series chassis have two grounding receptacles. (See Figure 3-8.)

Step 2 Attach the cable-management bracket to the two grounding receptacles that were not used to ground the chassis in the "Attaching a System Ground Connection" section on page 3-4.

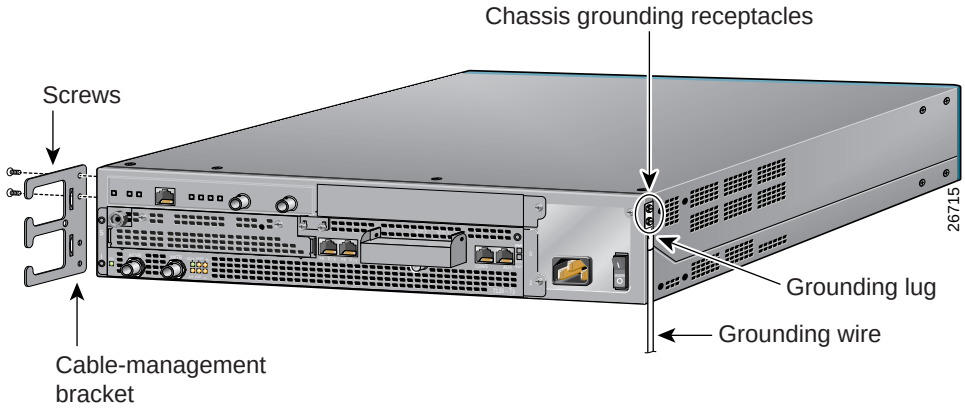
Step 3 Align the cable-management bracket to the vacant receptacles. Ensure the two flanges on the bracket are facing away from the chassis.

Step 4 Thread two M3.5 x 7-mm slotted hexhead screws through the bracket and into the chassis.

Step 5 Tighten the screws using a flat-head screwdriver.

Step 6 Secure any interface cables to the bracket flanges, using tie wraps.

Figure 3-8 Attaching the Cable-Management Bracket to the Chassis



This completes the steps for installing the cable-management bracket on a Cisco 7100 series router. Carefully lace interface cables through the cable-management bracket as needed.

Connecting to the Network

This section describes how to connect the router to your network. Cables to connect the router to a network are not provided. Contact customer service for ordering information. (See the "Cisco.com" section on page xix.) For cable product numbers and port pinouts, see Appendix C, "Cable Specifications."

The router arrives with the integrated services module (ISM), VPN Acceleration Module (VAM), and modular port adapter already installed, unless you order the VAM or modular port adapter as a spare. See the installation and configuration note for the specific port adapter, and the "Port Adapters" section on page 1-23 for more information on port adapters. See the *Integrated Service Adapter and Integrated Service Module Installation and Configuration* guide and the "Integrated Service Module (ISM)/Integrated Service Adapter (ISA)" section on page 1-23 for information on the ISM and ISA. See the *VPN Acceleration Module (VAM) Installation and Configuration* guide and the "VPN Acceleration Module (VAM)" section on page 1-26 for information on the VAM.

Warning **Do not work on the system or connect or disconnect cables during periods of lightning activity.**

Before opening the chassis, disconnect the telephone-network cables to avoid contact with telephone-network voltages.

Hazardous network voltages are present in WAN ports regardless of whether power to the unit is OFF or ON. To avoid electric shock, use caution when working near WAN ports. When detaching cables, detach the end away from the unit first.

Connecting the Fast Ethernet Ports

The 10BaseT/100BaseTX Fast Ethernet ports support IEEE 802.3 and IEEE 802.3u specifications for 10-Mbps and 100-Mbps transmission over unshielded twisted-pair (UTP) cables. These ports also support autosensing and autonegotiation of the proper transmission mode (half duplex or full duplex) with an attached device.

Each Fast Ethernet port has an RJ-45 connector that supports standard straight-through and crossover Category 3 or Category 5 UTP cable. Cisco Systems does not supply Category 3 or Category 5 UTP RJ-45 cables; these cables are available commercially.

Use Category 3 UTP crossover cables when connecting a 10BaseT port to a hub or use Category 3 UTP straight-through cables when connecting to an end station.

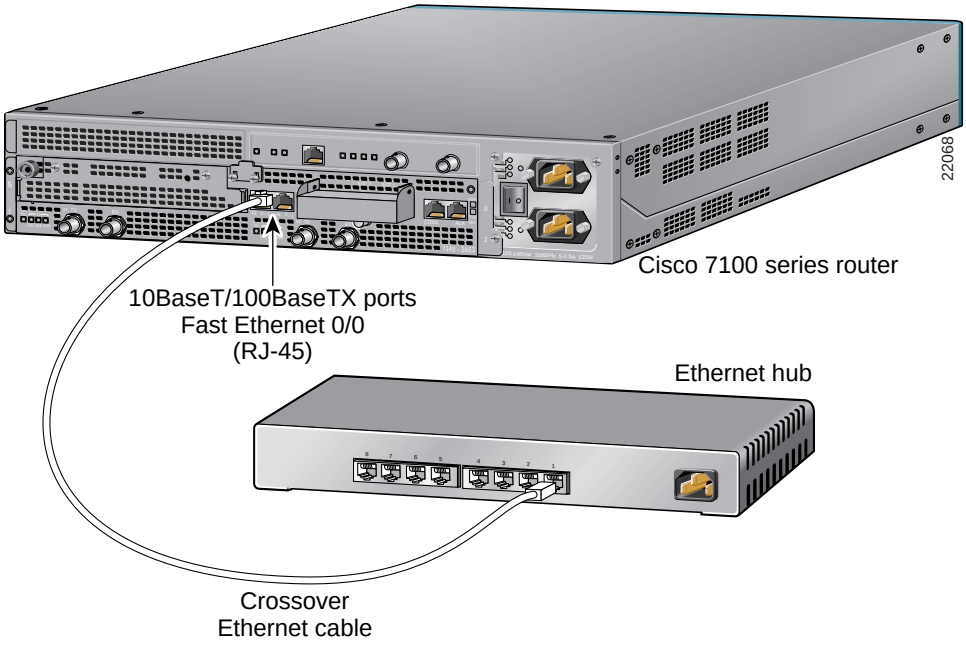
Use Category 5 UTP crossover cables when connecting 100BaseTX to a hub or use Category 5 UTP straight-through cables when connecting to an end station.

To connect the Fast Ethernet port to an Ethernet hub, use the following procedure:

Step 1 Attach the appropriate cable directly to the receptacle on the router. (See Figure 3-9.)

Step 2 Attach the network end of the cable to an Ethernet hub or end station.

Figure 3-9 Connecting the LAN Port to an Ethernet Hub



Note For more information, see the "Fast Ethernet Port Cables and Pinouts" section on page C-4.

Connecting the Cisco 7120-4T1 and Cisco 7140-8T

The four T1 ports on the Cisco 7120-4T1 and eight T1 ports on the Cisco 7140-8T and adapter cables allow a high density of interface ports, regardless of the size of the connectors typically used with each electrical interface type. All ports use an identical 60-pin D-shell receptacle that supports all interface types:

- EIA/TIA-232
- V.35
- EIA/TIA-449
- X.21
- EIA-530

Each port requires a serial adapter cable, which provides the interface between the high-density serial port and the standard connectors that are commonly used for each electrical interface type.

The adapter cable determines the electrical interface type and mode of the port (data terminal equipment [DTE] or data communications equipment [DCE]) to which it is connected.

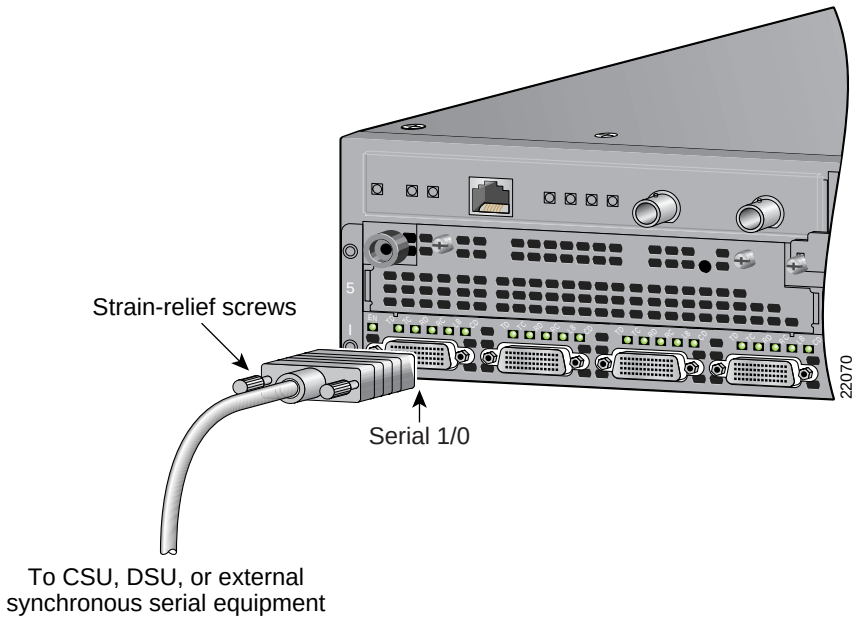
At system startup or restart, the network processor polls the interfaces and determines the electrical interface type of each port (according to the type of cable attached). However, it does not necessarily repoll an interface when you change the cable. To ensure that the system recognizes the new interface type, use the **shutdown** interface command before replacing the cable. After you replace the cable, use the **no shutdown** interface command to enable the interface.

To connect a serial cable to the network, use the following procedure:

Step 1 Attach the appropriate serial cable directly to the receptacle on the router and tighten the strain-relief screws. (See .)

Step 2 Attach the network end of the serial cable to a data service unit (DSU), channel service unit (CSU), DTE, or other external synchronous serial equipment and tighten the strain-relief screws.

Figure 3-10 Connecting the T1 WAN Serial Ports on the Cisco 7120-4T1 or Cisco 7140-8T



Caution Serial interface cables must be attached correctly or damage to the cable plug will result. Attempting to force a cable plug on the 60-pin receptacle can damage the plug. (See Appendix C, "Cable Specifications," for additional information.)

Note For more information, see the "Cisco 7120-4T1 and Cisco 7140-8T Cables and Pinouts" section on page C-5.

Connecting the Cisco 7120-T3, Cisco 7120-E3, Cisco 7140-2T3, and Cisco 7140-2E3

Use a 75-ohm coaxial cable to connect your router to a T3 or E3 serial network. Serial cables conform to EIA/TIA-612 and EIA/TIA-613 specifications. The T3 or E3 serial ports on the router are considered to be DTE devices.

The Cisco 7100 T3 and E3 models have the following port configurations:

- Cisco 7120-T3—One T3 serial port
- Cisco 7120-E3—One E3 serial port
- Cisco 7140-2T3—Two T3 serial ports
- Cisco 7140-2E3—Two E3 serial ports

Each T3 or E3 serial port has two connectors (receive and transmit), where you connect the Cisco 75-ohm coaxial cable. The 75-ohm coaxial cable (Cisco product number CAB-ATM-DS3/E3) is available only from Cisco Systems; it is *not* available from outside commercial cable vendors.

The Cisco 75-ohm coaxial cable is available only in 10-foot (3.05-meter) lengths. The typical maximum distance between stations for T3 and E3 transmissions is 1300 feet (396 meters).

Note For E3 (75-ohm) connections, you must have ferrite beads on the 75-ohm coaxial cable and electromagnetic interference (EMI) decoupling clips on the receiver end of the cable (see Figure 3-12) if compliance with European certification standards for emission control is required (EN55022/CISPR22 Class B for radiated emission levels).

Note The T3 and E3 ports support several types of integrated DSUs. For a listing of the interoperability guidelines, see Appendix C, "Cable Specifications."

To connect the T3 or E3 port to the network, use the following procedure:

Step 1 Attach the appropriate coaxial cable directly to the receptacle on the router. (See Figure 3-11 and Figure 3-12.)

Step 2 Attach the network end of the cable to the external synchronous serial equipment.

Figure 3-11 Connecting the T3 WAN Serial Ports on the Cisco 7140-2T3

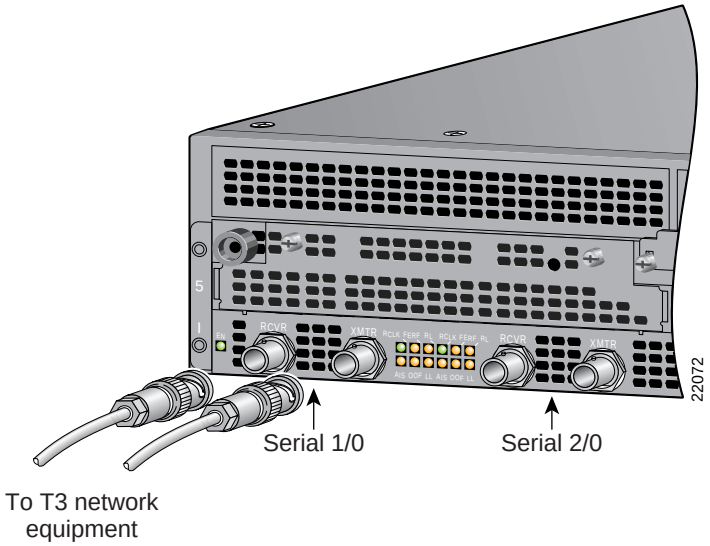
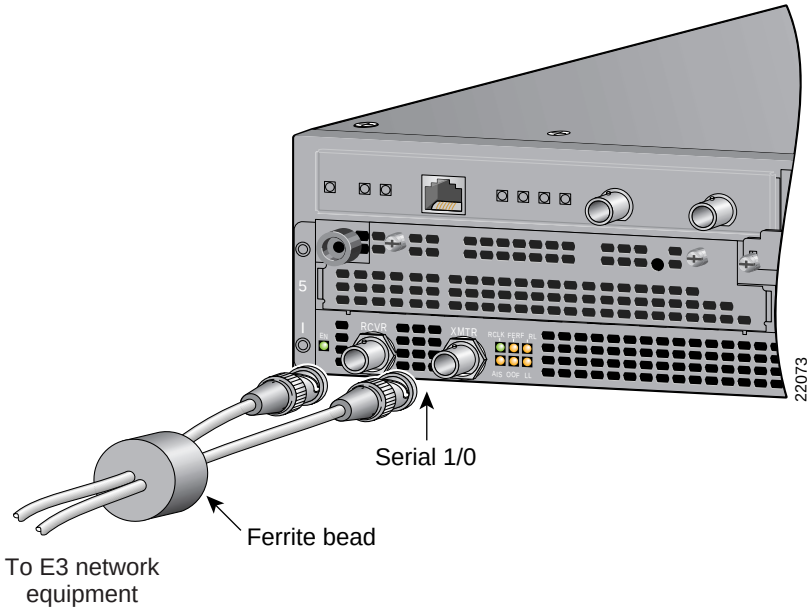


Figure 3-12 Connecting the E3 WAN Serial Ports on the Cisco 7120-E3



You can test the DTE-to-DCE cable connection by using the **loopback** command.

Note For more information, see the "Cisco 7120-T3, Cisco 7120-E3, Cisco 7140-2T3, and Cisco 7140-2E3 Cables" section on page C-18.

Connecting the Cisco 7120-AT3, Cisco 7120-AE3, Cisco 7140-2AT3, and Cisco 7140-2AE3

Use a 75-ohm coaxial cable to connect your router to an ATM T3 or E3 network. The cables conform to EIA/TIA-612 and EIA/TIA-613 specifications. The ATM T3 or E3 ports on the router are considered DTE devices.

The Cisco 7120 series ATM models have the following port configurations:

- Cisco 7120-AT3—One ATM T3 port
- Cisco 7120-AE3—One ATM E3 port
- Cisco 7140-2AT3—Two ATM T3 ports
- Cisco 7140-2AE3—Two ATM E3 ports

AT3 or AE3 ports consist of two connectors, transmit and receive. The 75-ohm coaxial cable (Cisco product number CAB-ATM-DS3/E3) is available only from Cisco Systems; it is *not* available from outside commercial cable vendors.

The Cisco 75-ohm coaxial cable is available only in 10-foot (3.05-meter) lengths. The typical maximum distance between stations for T3 and E3 transmissions is 1300 feet (396 meters).

Note To ensure compliance with EMI and European certification standards for emission control (EN55022/CISPR22 Class B for radiated emission levels), the Tx and Rx cables should be tied together along their entire length, and ferrite beads should be installed on each cable near the Tx and Rx connectors.

To connect the ATM T3 or E3 port to the network, use the following procedure:

Step 1 Attach the appropriate coaxial cable directly to the receptacle on the router. (See Figure 3-13.)

Step 2 Attach the network end of the cable to the external synchronous serial equipment.

Figure 3-13 Connecting the ATM T3 WAN Ports on the Cisco 7140-2AT3

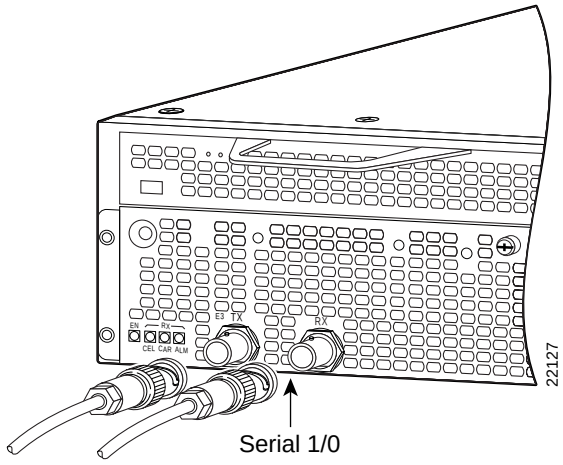
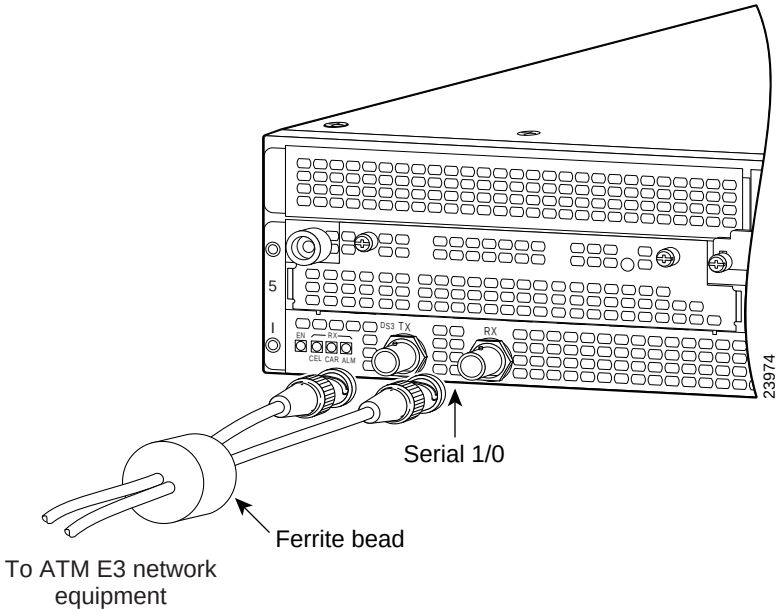


Figure 3-14 Connecting the ATM E3 WAN Ports on the Cisco 7140-2AE3



Note For more information, see the "Cisco 7120-AT3, Cisco 7140-2AT3, Cisco 7120-AE3, Cisco 7140-2AE3, Cisco 7120-SMI3, and Cisco 7140-2MM3 Cables" section on page C-19.

Connecting the Cisco 7120-SMI3 and Cisco 7140-2MM3

The SMI3 (OC-3c/STM-1 single-mode intermediate reach) and MM3 (OC-3c/STM-1 multimode) interfaces provide an interface to ATM switching fabrics for transmitting and receiving data at rates of up to 155 Mbps bidirectionally. The MM3 and SMI3 interfaces connect to the SONET/SDH, 155-Mbps multimode or single-mode optical fiber.

For SONET/SDH multimode and SONET/SDH single-mode connections, use one duplex SC connector or two simplex SC connectors. The simplex and duplex SC connectors are shipped with removable dust covers on each connector. These cables are not available from Cisco.

For information on SONET specifications for fiber-optic transmissions, understanding power budget, and assistance with approximating the power margin for multimode and single-mode transmissions, see Appendix C, "Cable Specifications."

Warning **Class 1 laser product.**

Because invisible laser radiation may be emitted from the aperture of the port when no fiber cable is connected, avoid exposure to laser radiation and do not stare into open apertures.

To connect the ATM OC-3c/STM-1 port to the network, use the following procedure:

Step 1 Attach the appropriate fiber cable directly to the receptacle on the router. (See Figure 3-15 and Figure 3-16.)

Step 2 Attach the network end of the cable to an external DSU (an ATM network).

Figure 3-15 Connecting the ATM SMI WAN Ports on the Cisco 7120-SMI3

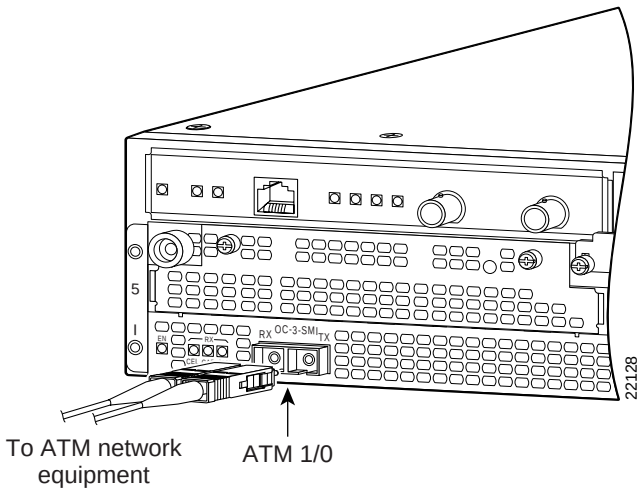
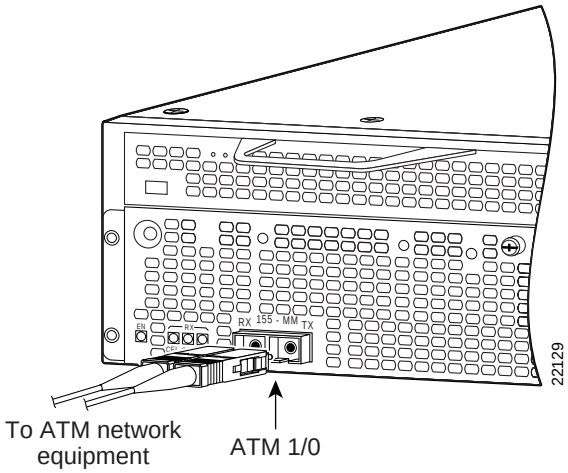


Figure 3-16 Connecting the ATM MM WAN Ports on the Cisco 7140-2MM3



Note For more information, see the "Cisco 7120-AT3, Cisco 7140-2AT3, Cisco 7120-AE3, Cisco 7140-2AE3, Cisco 7120-SMI3, and Cisco 7140-2MM3 Cables" section on page C-19.

Connecting the Console Port and Auxiliary Port

The router arrives with a console and auxiliary cable kit, which contains the cable and adapters you need to connect a console (an ASCII terminal or PC running terminal emulation software) or modem to the router. The console and auxiliary cable kit includes:

- RJ-45-to-RJ-45 rollover cable
- RJ-45-to-DB-9 female DTE adapter (labeled TERMINAL)
- RJ-45-to-DB-25 female DTE adapter (labeled TERMINAL)
- RJ-45-to-DB-25 male DCE adapter (labeled MODEM)

Connecting to the Console Port

Use the console terminal for local administrative access to the router. You can connect a terminal to the console port only.

To connect the console port to a terminal (an ASCII terminal or a PC running terminal emulation software), use the following procedure:

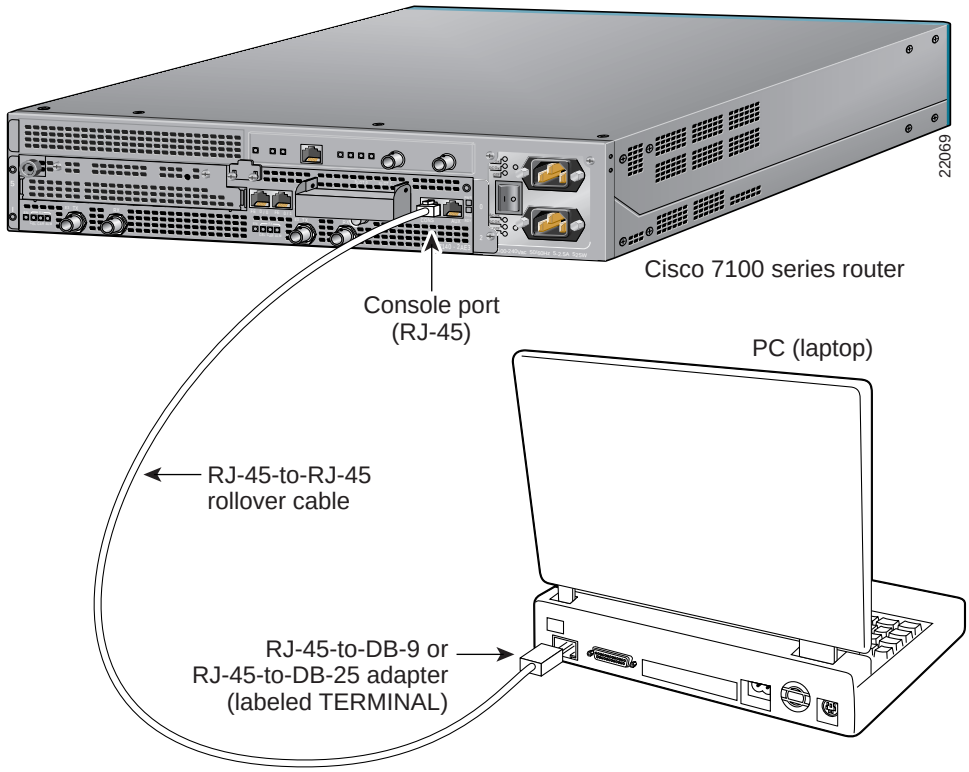
Step 1 Attach the appropriate cable (RJ-45 rollover cable and an RJ-45-to-DB-25 or RJ-45-to-DB-9 adapter) directly to the receptacle on the router. (See Figure 3-17.) The adapters provided are labeled TERMINAL. Other types of adapters are not included

Step 2 Attach the other end of the cable to a terminal or PC.

Step 3 Configure the terminal or PC terminal emulation software for 9600 baud, 8 data bits, no parity, 2 stop bits, and no flow control.

Note If the emulation software flow control setting is “hardware,” the router does not accept input.

Figure 3-17 Connecting the Console Terminal



Note For more information, see the "Console and Auxiliary Port Cables and Pinouts" section on page C-1.

Connecting a Modem to the Auxiliary Port

You can use the auxiliary port to connect a terminal or a modem for remote access to the router.

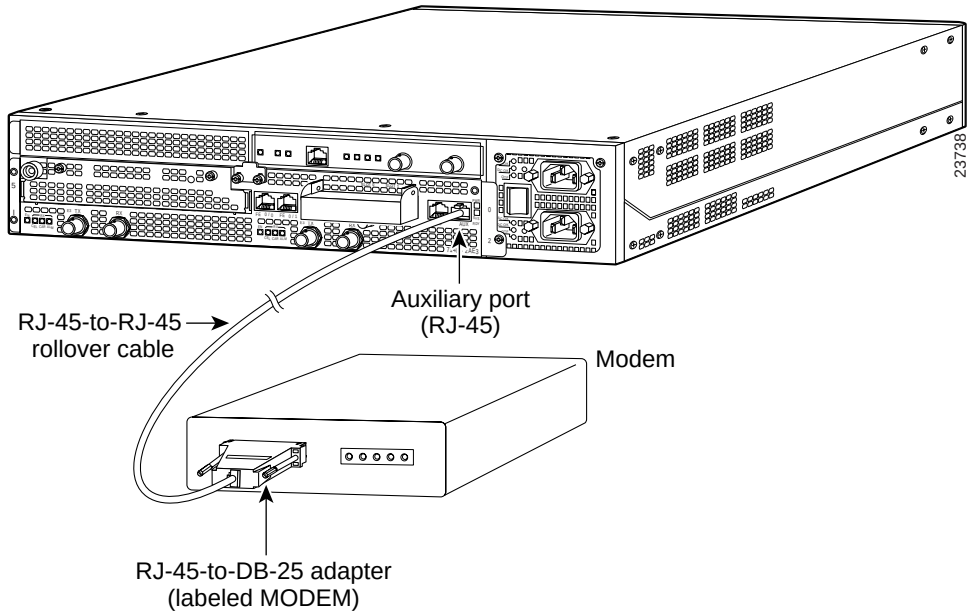
To connect the auxiliary port to a modem, use the following procedure:

Step 1 Attach the RJ-45 rollover cable with an RJ-45-to-DB-25 adapter directly to the auxiliary receptacle on the router. (See Figure 3-18.) The adapter provided is labeled MODEM.

Step 2 Attach the other end of the cable to the modem.

Step 3 Confirm that the modem and the auxiliary port on the router are configured for the same transmission speed (38400 baud is typical) and hardware flow control with Data Carrier Detect (DCD) and Data Terminal Ready (DTR) operations.

Figure 3-18 Connecting a Modem to the Auxiliary Port



This completes the procedure for connecting a modem to the auxiliary port. For more information, see the "Cable Specifications" section on page C-1.

Connecting the Power

Cisco 7120 series and Cisco 7140 series routers feature four-output switching AC power supplies that provide power factor correction and regulated outputs. Cisco 7120 series routers have one AC-input power supply and Cisco 7140 series routers have two AC-input power supplies.

Cisco 7140 series routers will operate with power connected to either of the two power supplies. The second AC-input power supply simply enables power load-sharing and redundancy. There is no primary or secondary power supply for Cisco 7140 series routers.

For information on the power supply specifications, see Appendix B, "System Specifications."

Warning **Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is off and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected.**

The AC power supply has double pole/neutral fusing.

Check the following conditions before you start the router:

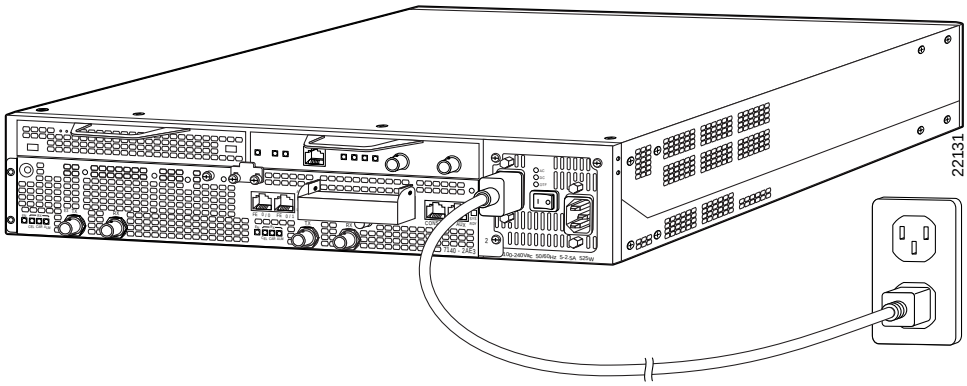
- The port adapter is securely inserted in its slot.
- All network interface cables are connected.
- A Flash Disk or Flash memory card is installed in its PC Card slot.
- The console terminal is connected and powered on.

To connect the AC power on Cisco 7120 series routers, use the following procedure:

Step 1 Turn the power switch to the off (O) position.

Step 2 Connect one end of the power cord to the power connector on the back of the router. (See Figure 3-19.)

Figure 3-19 Connecting the AC Power Cord



Step 3 Connect the other end of the power cord to the power outlet.

Warning **The plug-socket combination must be accessible at all times because it serves as the main disconnecting device.**

To connect the AC power on Cisco 7140 series routers (for power load-sharing and redundancy), use the following procedure to connect the second power supply.

Cisco 7140 series routers will operate with power connected to either of the two power supplies. The second AC-input power supply simply enables power load-sharing and redundancy. There is no primary or secondary power supply for the Cisco 7140 series routers.

Step 1 At the back of the router, check that the power switch is in the off (O) position.

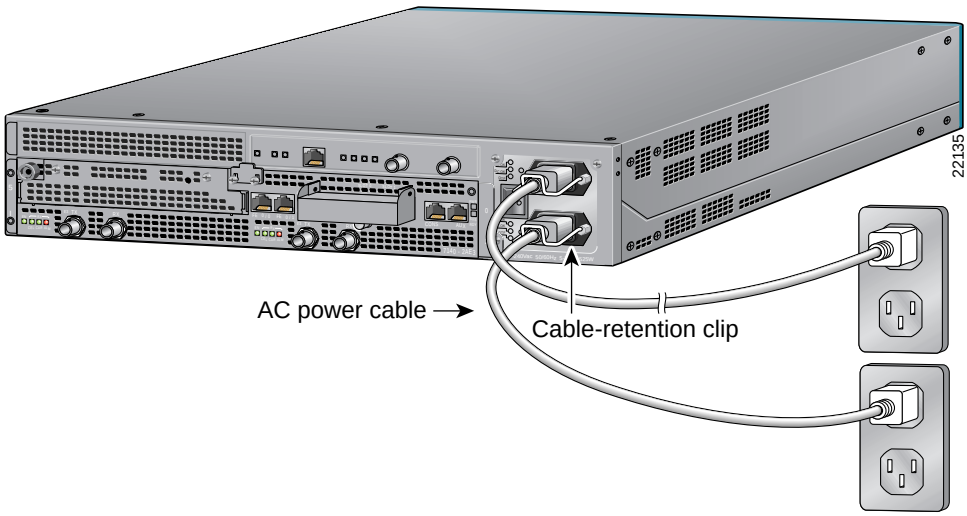
Step 2 Slide the cable-retention clip up, away from the second AC-input receptacle, and plug in the power cable.

Step 3 Secure the cable in the power supply AC-input receptacle by sliding the cable-retention clip down until it fits around the connector. The cable-retention clip provides strain relief for the AC power cable. (See Figure 3-20.)

Note For additional AC power cable strain relief, secure the cable to the power supply handle by inserting a nylon cable tie through the hole in the handle and around the cable.

Step 4 Plug the AC power supply cable for the second power supply into the AC power source.

Figure 3-20 Connecting a Second AC Power Cord



Note For information on system startup and software configuration, see Chapter 4, "Performing a Basic Startup Configuration."

Performing a Basic Startup Configuration

This chapter describes how to start the system and perform a basic configuration for your Cisco 7100 series router. The chapter includes the following sections:

- Checking Conditions Prior to System Startup, page 4-1
- Starting the System and Observing Initial Conditions, page 4-1
- Configuring a Router, page 4-3
- Performing Other Configuration Tasks, page 4-19
- Viewing the System Configuration, page 4-19
- Replacing or Recovering a Lost Password, page 4-21

Complex configuration procedures are beyond the scope of this publication. See the "Related Documentation" section on page xi for additional information.

Checking Conditions Prior to System Startup

Check the following conditions before you start your router:

- Each port adapter is securely inserted in its slot.
- All network interface cables are connected.
- A Flash Disk or Flash memory card is installed in its PC Card slot.
- The power cable is connected and secured with the cable-retention clip.
- The console terminal is connected and powered on.

Starting the System and Observing Initial Conditions

After installing the router and connecting cables, start the router as follows:

Step 1 Turn the power switch on the power supply to the on (|) position. The green power (PWR) LED on the router goes on.

Step 2 Listen for the fans; you should immediately hear them operating.

Step 3 During the boot process, observe the system LEDs. The LEDs on most of the fixed interfaces and port adapters go on and off in irregular sequence. Some may go on, go out, and go on again for a short time.

Note The boot LED remains lit when the ISA/ISM is configured for MPPE, and it starts to pulsate after booting when the ISA/ISM is configured for IPSec. The ISA/ISM functions normally whether the boot LED is pulsating or is solid. See the *Integrated Service Adapter and Integrated Service Module Installation and Configuration* for more information on configuring the ISA/ISM.

Step 4 Observe the initialization process. When the system boot is complete (a few seconds), the network processor begins to initialize the interfaces. During this initialization, the LEDs on each port behave differently (most flash on and off).

The enabled (EN) LED on each interface goes on when initialization is completed, and the console screen displays a script and system banner similar to the following:

```
              Restricted Rights Legend

Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.

           cisco Systems, Inc.
           170 West Tasman Drive
           San Jose, California 95134-1706
```

Step 5 When you start up the router for the first time, the system automatically enters the **setup** command facility, which determines which interfaces are installed and prompts you for configuration information for each one. On the console terminal, after the system displays the system banner and hardware configuration, you will see the following System Configuration Dialog prompt:

```
--- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]:
```

You have the option of proceeding with the setup facility to configure the interfaces, or exiting from setup and using configuration commands to configure global (system-wide) and interface-specific parameters. You do not have to configure the interface immediately; however, you cannot enable the interfaces or connect them to any networks until you have configured them.

- To continue with setup—Enter **yes** and proceed to the "Performing a Basic Configuration Using the Setup Facility" section on page 4-4.
- To use global configuration mode to enter commands manually—Enter **no** and proceed to the "Performing a Basic Configuration Using Global Configuration Mode" section on page 4-7.

Some interface LEDs do not light until you have configured them. Complete the first-time startup procedures and configuration, and then refer to the LED descriptions in Chapter 1, "Overview," to check the status of the interfaces.

For specific port and service adapters specific to the Cisco 7100 series VPN routers, see the *Cisco 7100 Series VPN Router Documentation* flyer, and refer to the specific configuration and installation guide for your port adapter for information.

For troubleshooting recommendations and procedures, see Chapter 5, "Troubleshooting the Installation."

Configuring a Router

You can configure or modify the configuration of the router using one of the procedures described in the following sections:

- Performing a Basic Configuration Using AutoInstall, page 4-3
- Performing a Basic Configuration Using the Setup Facility, page 4-4
- Performing a Basic Configuration Using Global Configuration Mode, page 4-7

Follow the procedure that best fits the needs of your network configuration.

Note You need to acquire the correct network addresses from your system administrator or consult your network plan to determine correct addresses before you can complete the router configuration.

Enter the **show version** command to display the router model and the release of Cisco IOS software that is supported on the router. (See the "Viewing the System Configuration" section on page 4-19 for sample output of the **show version** command.)

Performing a Basic Configuration Using AutoInstall

The AutoInstall process configures the router automatically after connection to the WAN. A Transmission Control Protocol/Internet Protocol (TCP/IP) host on your network must be preconfigured to provide the required configuration files. The TCP/IP host may exist anywhere on the network provided the following two conditions are met:

1. The host must be on the remote side of the router's synchronous serial connection to the WAN.
2. User Datagram Protocol (UDP) broadcasts to and from the router and the TCP/IP host are enabled.

Do not use AutoInstall unless the required files are available on the TCP/IP host. Refer to the publications *Configuration Fundamentals Configuration Guide* and *Configuration Fundamentals Command Reference* for information about how AutoInstall works. (See "Related Documentation" section on page xi for more information.

To configure the router using AutoInstall, complete the following steps:

Step 1 Attach the appropriate synchronous serial cable to an available synchronous serial interface on the router.

Step 2 Turn the power switch on the power supply to the on (|) position. (This action supplies AC power to the router.)

The router loads the operating system image from Flash memory. If the remote end of the WAN connection is connected and properly configured, the AutoInstall process begins.

Step 3 After the AutoInstall process is complete, use the **copy running-config startup-config** command to write the configuration data to the router's nonvolatile random-access memory (NVRAM).

```
Hostname# copy running-config startup-config
```

Note This step saves the configuration settings to NVRAM. If you fail to do this, your configuration will be lost the next time you reload the router.

Performing a Basic Configuration Using the Setup Facility

If you do not plan to use AutoInstall, do not connect the router's serial (WAN) cable to the network. The router boots from Flash memory and goes automatically into the setup facility, if the WAN interface is not connected.

You can run the setup facility any time you are at the privileged-level (enable) prompt (#) by entering the command **setup**.

Note If the router does not have a configuration stored in NVRAM, the router attempts to run AutoInstall at startup. After the router determines that AutoInstall is not configured, it defaults to the setup facility.

Configure the global parameters and interface parameters, if you have not already done so (see "Using the EXEC Command Interpreter" section on page 4-8). Global parameters are used for controlling system-wide settings. Interface parameters are used to create a connection over a LAN or WAN.

Complete the following steps to perform a basic configuration using the setup facility:

Step 1 Ensure that a console terminal is connected to the console port, and then boot the router.

The system boots from Flash memory. The following information appears after about 30 seconds. When you see this information, you have successfully booted your router:

```
               Restricted Rights Legend

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Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.

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           170 West Tasman Drive
           San Jose, California 95134-1706



Cisco Internetwork Operating System Software
IOS (tm) EGR Software (c7100-P-M), Released Version 12.0(4)XE
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Mon 07-Jun-99 10:25 by biff
Image text-base:0x600088F8, data-base:0x60A54000

cisco 7140-2T3 (EGR) processor with 61440K/69632K bytes of memory.
R7000 CPU at 262Mhz, Implementation 39, Rev 1.0, 256KB L2, 2048KB L3 Cache
Last reset from power-on
X.25 software, Version 3.0.0.
3 FastEthernet/IEEE 802.3 interface(s)
2 Serial network interface(s)
125K bytes of non-volatile configuration memory.

40960K bytes of ATA PCMCIA card at slot 0 (Sector size 512 bytes).
4096K bytes of Flash internal SIMM (Sector size 256K).


Press RETURN to get started!
```

Note The banner and the installed hardware sections of the configuration script appear only at initial system startup.

Step 2 Enter **yes** or press **Return** to begin the initial configuration dialog.

```
--- System Configuration Dialog ---

Would you like to enter the initial configuration dialog? [yes/no]: yes
At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.

Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

First, would you like to see the current interface summary? [yes]:

In the following example, the summary shows a router at first-time startup; that is,
nothing is configured. The type of interfaces varies depending on the type of Cisco 7100
series router you are using and the type of modular port adapter that is installed in the
router.

Any interface listed with OK? value “NO” does not have a valid configuration

Interface            IP-Address      OK? Method  Status   Protocol
FastEthernet0/0      unassigned      NO  unset   up       up
FastEthernet0/1      unassigned      NO  unset   up       up
ATM1/0               unassigned      NO  unset   down     down
ATM2/0               unassigned      NO  unset   down     down
```

Step 3 Enter the router host name, enable secret password, enable password, and virtual terminal password.

```
Configuring global parameters:

  Enter host name [Router]: sanjose

  The enable secret is a password used to protect access to
  privileged EXEC and configuration modes. This password, after
  entered, becomes encrypted in the configuration.
  Enter enable secret: barney

  The enable password is used when you do not specify an
  enable secret password, with some older software versions, and
  some boot images.
  Enter enable password: betty

  The virtual terminal password is used to protect
  access to the router over a network interface.
  Enter virtual terminal password: fred
```

Step 4 Decide whether you want to configure Simple Network Management Protocol (SNMP).

Enter **yes** or press **Return** to accept SNMP management; enter **no** to refuse it.

```
Configure System Management? [yes/no]: no
  Configure SNMP Network Management? [yes]: no
```

Step 5 Choose which protocols to support on your interfaces. For IP-only installations, accept the default values for most questions. If you are using IP routing, also select one or two of the following interior routing protocols, using the setup facility: Interior Gateway Routing Protocol (IGRP) or Routing Information Protocol (RIP).

To configure IP routing, enter **yes** (the default) or press **Return**, and then select an interior routing protocol.

```
Configure IP? [yes]: yes
  Configure IGRP routing? [yes]: yes
    Your IGRP autonomous system number [1]: 15
  Configure CLNS? [no]: no
```

Step 6 Configure the Fast Ethernet LAN port in slot 0, using your own addresses and subnet mask at the setup prompts.

```
Configuring interface parameters:

Do you want to configure FastEthernet0/0 interface? [yes]: yes
  Use the 100 Base-TX (RJ-45) connector? [yes]: yes
  Operate in full-duplex mode? [no]: yes
  Configure IP on this interface? [yes]: yes
    IP address for this interface: 10.1.1.1
    Subnet mask for this interface [255.0.0.0]:
    Class A network is 10.0.0.0, 8 subnet bits; mask is /8

Do you want to configure FastEthernet0/1 interface? [yes]: no
```

Step 7 Configure the ATM port in slot 1. Use your own addresses and subnet mask at the setup prompts.

```
Do you want to configure ATM1/0 interface? [yes]: yes
  Configure IP on this interface? [yes]: yes
    IP address for this interface: 10.1.1.2
    Subnet mask for this interface [255.0.0.0]:
    Class A network is 10.0.0.0, 8 subnet bits; mask is /8

Do you want to configure ATM2/0 interface? [yes]:no
```

Step 8 Configure the synchronous serial port in slot 4. Use your own addresses and subnet mask at the setup prompts.

```
Do you want to configure Serial4/0 interface [yes]:
Configure IP on this interface? [yes]:
    IP address for this interface: 10.1.1.3
    Number of bits in subnet field [0]:
    Class A network is 10.1.1.0, 0 subnet bits; mask is /24
```

Step 9 Review your configuration to view your changes before they are made permanent. The program also asks you if you want to use this configuration.

```
The following configuration command script was created:

hostname sanjose
enable secret 5 $1$gG.I$gc9JUfK2r6pIDL0vo3j191
enable password betty
line vty 0 4
password fred
no snmp-server
!
ip routing
no clns routing
!
interface FastEthernet0/0
 ip address 10.1.1.1 255.255.0.0
```

```
 no ip directed-broadcast
 duplex auto
 speed auto
!
interface ATM1/0
 ip address 10.1.1.2 255.255.255.0
 ip broadcast-address 3.3.3.255
 no ip directed-broadcast
 shutdown
 duplex auto
 speed auto
!
interface Serial4/0
 ip address 10.1.1.3
 no ip directed-broadcast
 shutdown
 framing c-bit
 cablelength 10
 dsu bandwidth 44210
!
router igrp 200
 network 10.0.0.0
!
end
```

Step 10 Save the settings to NVRAM.

```
[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.

Enter your selection [2]: 2
```

Your router is now minimally configured and ready to use. You can use the **setup** command if you want to modify the parameters after the initial configuration. To perform more complex configurations, use the **configure** command.

Performing a Basic Configuration Using Global Configuration Mode

You will need the following information before beginning the procedures in this section:

- Host name of the router and any passwords you plan to use
- Protocols you plan to route on each new interface
- IP addresses if you plan to configure the interfaces for IP routing
- Timing source for each new interface and clock speeds for external timing

The **configure** command requires privileged-level access to the EXEC command interpreter, which usually requires a password. Contact your system administrator if necessary to obtain EXEC-level access.

Using the EXEC Command Interpreter

You modify the configuration of your router through the software command interpreter called the *EXEC* (also called enable mode). You must enter the privileged level of the EXEC command interpreter with the **enable** command before you can use the **configure** command to configure a new interface or change the existing configuration of an interface. The system prompts you for a password if one has been set.

The system prompt for the privileged level ends with a pound sign (#) instead of an angle bracket (>). At the console terminal, use the following procedure to enter the privileged level:

Step 1 At the user-level EXEC prompt, enter the **enable** command. The EXEC prompts you for a privileged-level password as follows:

```
Router> enable

Password:
```

Step 2 Enter the password (the password is case sensitive). For security purposes, the password is not displayed.

When you enter the correct password, the system displays the privileged-level system prompt (#):

```
Router#
```

Step 3 Enter the **configure terminal** command at the enable prompt to enter configuration mode from the terminal.

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
```

At this point, you can configure the router's host name, passwords, and other global configurations.

Note To see a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in configuration mode. For more information, refer to the *Configuration Fundamentals Configuration Guide* and the *Configuration Fundamentals Command Reference*. See "Related Documentation" section on page xi for more information.

Step 4 At this point, you can either:

- Save your configuration—See the "Saving the Running Configuration to NVRAM" section on page 4-17).
- Configure the fixed interfaces on the router as follows:
  - Configuring the Fast Ethernet Interfaces, page 4-9
  - Configuring the T1 and E1 Interfaces, page 4-10
  - Configuring the T3 Interfaces, page 4-11
  - Configuring the E3 Interfaces, page 4-13
  - Configuring the ATM Interfaces, page 4-15

Configuring the Fast Ethernet Interfaces

The Cisco 7100 series VPN routers have two 10BaseT/100BaseTX autosensing Ethernet/Fast Ethernet interfaces equipped with RJ-45 receptacles.

To configure the Fast Ethernet interfaces, use the **duplex** command and the **speed** command. To fully enable autonegotiation on the Fast Ethernet interfaces, use the **duplex auto** command and the **speed auto** command.

The default settings and the commands to change the defaults are listed in Table 4-1.

Table 4-1 Fast Ethernet Interface Defaults

Attribute	Default Value	Command
Duplex mode	Autonegotiation[1]	**duplex** {**full** | **half** | **auto**} **no duplex**
Speed	Autonegotiation	**speed** {**10** | **100** | **auto**} **no speed**

1. In Cisco IOS Release 12.0(4)XE, the default value for duplex mode is half duplex and the default value for speed is 100 Mbps. In Cisco IOS Release 12.0(5)XE or later releases of 12.0 XE, and in Cisco IOS Release 12.0(6)T or later releases of 12.0 T, the default value for duplex mode and speed is autonegotiation.

If the connected Fast Ethernet port does not support autonegotiation or is not configured for autonegotiation, then the router uses a method called parallel detection which can determine speed, but not duplex. In this case the autosensensing Fast Ethernet port on your Cisco 7100 series router will default to half-duplex mode.

To configure the Fast Ethernet port 0, follow the steps below:

Step 1 At the `Router (config)#` prompt, enter the **interface** *type slot/port* command to enter the interface configuration mode. In this example, Fast Ethernet port 0 is configured:

```
Router(config)# interface fastethernet 0/0
Router(config-if)#
```

You can now enter any changes to the configuration.

Note To see a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in configuration mode.

Step 2 Specify the IP address. The following example uses an IP address of 10.1.1.20:

```
Router(config-if)# ip address 10.1.1.20 255.0.0.0
```

Step 3 Change a default setting or configure other features on the interface, as needed.

The following example shows you how to change the duplex mode (autonegotiation is the default) and the speed (autonegotiation is the default):

```
Router(config-if)# duplex half
Router(config-if)# speed 10
```

Note For more information on configuring interfaces, refer to the *Cisco IOS Interface Configuration Guide* and the *Cisco IOS Interface Command Reference* publications. See "Related Documentation" section on page xi for more information.

Step 4 Enable the interface.

```
Router(config-if)# no shutdown
```

Step 5 Configure additional interfaces as required.

Step 6 Press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter.

Step 7 Save the configuration to NVRAM as follows:

```
Router# copy running-config startup-config
[OK]
```

(See the "Saving the Running Configuration to NVRAM" section on page 4-17. Also see the "Checking the Interface Configurations" section on page 4-18 for examples of interface configurations.)

Configuring the T1 and E1 Interfaces

The Cisco 7120-4T1 provides four channel-independent, synchronous serial ports that support full-duplex operation at T1 (1.544-Mbps) and E1 (2.048-Mbps) speeds. The default settings and the commands to change the defaults are listed in Table 4-2.

Table 4-2 T1 and E1 Interface Defaults

Attribute	Default Value	Command
Duplex mode	Full duplex	**half duplex**
Clock rate	Uses the external timing signal	**clock rate**
Invert clock rate	Not inverted	**invert-txc**
NRZI encoding	NRZ format	**nrzi-encoding**
CRC 32	16 bits	**crc** *size* (16 or 32 bits)

Perform a basic interface configuration using the procedure below.

Note Additional configuration commands may be required, depending on your system requirements and the protocols you plan to route on the interface.

At any time, you can exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
```

Step 1 At the `Router (config)#` prompt, enter the **interface** *type slot/port* command to enter the interface configuration mode. In this example, the serial port 0 is configured:

```
Router(config)# interface serial 1/0
Router(config-if)#
```

Enter any changes to the configuration.

Note To see a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in configuration mode.

Step 2 Specify the IP address. The following example uses an IP address of 10.1.1.10:

```
Router(config-if)# ip address 10.1.1.10 255.0.0.0
```

Step 3 Change the default settings or configure other features on the interface as needed.

The following example sets the external clock rate to 72 kbps:

```
Router(config-if)# clockrate 72000
```

Enter the **clockrate ?** command for a list of valid clock rates. If you enter a nonstandard clock rate (that is, a rate not displayed by the **clockrate ?** command), the clock rate is rounded to the nearest value that the hardware can support. To determine the value that the clock rate was rounded to, use the **show running-configuration** command.

Set the external clock rate in bits-per-second if you are configuring a data communications equipment (DCE) interface or you want to perform a loopback test. Skip this step if you are configuring a data terminal equipment (DTE) interface; the interface automatically uses the external timing signal.

The T1 and E1 interfaces support both DTE and DCE mode, depending on the mode of the interface cable attached to the port.

The DCE interface generates its own clock signal (TxC) and sends it to the remote DTE. The remote DTE device returns the clock signal to the DCE. (See Table 4-2 for a list of commands used to change the default settings.)

Note For more information on configuring interfaces, refer to the *Cisco IOS Interface Configuration Guide* and the *Cisco IOS Interface Command Reference* publications. See "Related Documentation" section on page xi for more information.

Step 4 Enable the interface.

```
Router(config-if)# no shutdown
```

Step 5 Press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter.

Step 6 Save the new configuration to NVRAM as follows:

```
Router# copy running-config startup-config
[OK]
```

(See the "Saving the Running Configuration to NVRAM" section on page 4-17. Also see the "Checking the Interface Configurations" section on page 4-18 for examples of interface configurations.)

Configuring the T3 Interfaces

The Cisco 7120-T3 provides one and the Cisco 7140-2T3 provides two high-speed, synchronous serial ports that support full-duplex operation at T3 (45-Mbps) speeds. The default settings and the commands to change the defaults are listed in Table 4-3.

Table 4-3 T3 Interface Defaults

Attribute	Default Value	Command
Clock source	Line	**clock source**
DSU bandwidth	44210	**dsu bandwidth** *kbps* (22 to 44210)
DSU mode	0	**dsu mode** {**0** | **1** | **2**}
Scramble	Not enabled	**scramble** **no scramble**
Framing	C-bit	**framing** {**c-bit** }| **m13** | **bypass**}
Cable length	10 feet	**cablelength** *feet* (0 to 450)
CRC	16 bits	**crc** *size* (16 or 32 bits)

Perform a basic interface configuration using the procedure below.

Note Additional configuration commands may be required, depending on your system requirements and the protocols you plan to route on the interface.

At any time, you can exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
```

Step 1 At the `Router (config)#` prompt, enter the **interface** *type slot/port* command to enter the interface configuration mode. In this example, the serial port 0 is configured:

```
Router(config)# interface serial 1/0
Router(config-if)#
```

You can now enter any changes to the configuration.

Note To see a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in configuration mode.

Step 2 Specify the IP address. The following example uses an IP address of 10.1.1.30:

```
Router(config-if)# ip address 10.1.1.30 255.0.0.0
```

Step 3 Change the default settings or configure other features on the interface as needed.

The following example shows you how to set the clock source to internal (the default is line) and reduce the effective bandwidth (the default is 44210 kbps):

```
Router(config-if)# clock source internal
Router(config-if)# dsu bandwidth 16000
```

Note The local port configuration must match the remote port configuration. For example, if you reduce the effective bandwidth to 16000 on the local port, you must do the same on the remote port.

(See Table 4-3 for a list of commands used to change the default settings. Also see Table C-17 on page C-18 for information regarding data service unit [DSU] feature compatibilities.)

Note For more information on configuring interfaces, refer to the *Cisco IOS Interface Configuration Guide* and the *Cisco IOS Interface Command Reference* publications. See "Related Documentation" section on page xi for more information.

Step 4 Enable the interface.

```
Router(config-if)# no shutdown
```

Step 5 Press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter.

Step 6 Save the new configuration to NVRAM as follows:

```
Router# copy running-config startup-config
[OK]
```

(See the "Saving the Running Configuration to NVRAM" section on page 4-17. Also see the "Checking the Interface Configurations" section on page 4-18 for examples of interface configurations.)

Configuring the E3 Interfaces

The Cisco 7120-E3 provides one and the Cisco 7140-2E3 provides two high-speed, synchronous serial ports that support full-duplex operation at E3 (34-Mbps) speeds. The default settings and the commands to change the defaults are listed in Table 4-4.

Table 4-4 E3 Interface Defaults

Attribute	Default Value	Command
Clock source	Line	**clock source**
DSU bandwidth	34010	**dsu bandwidth** *kbps* (22 to 34010)
DSU mode	0	**dsu mode** {**0** | **1**}
National bit	0	**national bit** {**0** | **1**}
Scramble	Not enabled	**scramble** **no scramble**
Framing	G.751	**framing** {**bypass**[1] | **g751**}
Cable length	10 feet	**cablelength** *feet* (0 to 450)
CRC	16 bits	**crc** *size* (16 or 32 bits)

1. If you use the **bypass** option, scrambling must be set to the default, disabled; the DSU mode must be set to the default, 0; and the DSU bandwidth must be set to the default, 34010.

Perform a basic interface configuration using the procedure below.

Note Additional configuration commands may be required, depending on your system requirements and the protocols you plan to route on the interface.

At any time, you can exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
```

Step 1 At the `Router (config)#` prompt, enter the **interface** *type slot/port* command to enter the interface configuration mode. In this example, the serial port 0 is configured:

```
Router(config)# interface serial 1/0
Router(config-if)#
```

You can now enter any changes to the configuration.

Note To see a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in configuration mode.

Step 2 Specify the IP address. The following example uses an IP address of 10.1.1.40:

```
Router(config-if)# ip address 10.1.1.40 255.0.0.0
```

Step 3 Change the default settings or configure other features on the interface as needed.

The following example shows you how to set the clock source to internal (the default is line) and reduce the effective bandwidth (the default is 34010 kbps):

```
Router(config-if)# clock source internal
Router(config-if)# dsu bandwidth 16000
```

Note The local port configuration must match the remote port configuration. For example, if you reduce the effective bandwidth to 16000 on the local port, you must do the same on the remote port.

(See Table 4-4 for a list of commands used to change the default settings. See Table C-17 on page C-18 for information regarding DSU feature compatibilities.)

Note For more information on configuring interfaces, refer to the *Cisco IOS Interface Configuration Guide* and the *Cisco IOS Interface Command Reference* publications. See "Related Documentation" section on page xi for more information.

Step 4 Enable the interface.

```
Router(config-if)# no shutdown
```

Step 5 Press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter.

Step 6 Save the new configuration to NVRAM as follows:

```
Router# copy running-config startup-config
[OK]
```

(See the "Saving the Running Configuration to NVRAM" section on page 4-17. Also see the "Checking the Interface Configurations" section on page 4-18 for examples of interface configurations.)

Configuring the ATM Interfaces

The Cisco 7120-AT3 provides one and the Cisco 7140-2AT3 provides two high-speed, ATM ports that support full-duplex operation at T3 (45-Mbps) speeds. The Cisco 7120-AE3 provides one and the Cisco 7140-2AE3 provides two high-speed, ATM ports that support full-duplex operation at E3 (34-Mbps) speeds. The Cisco 7120-SMI3 provides one and the Cisco 7140-2MM3 provides two ATM ports that support full-duplex operation at OC-3c/STM1 single-mode intermediate reach or multimode (155-Mbps) speeds. The default settings and the commands to change the defaults are listed in Table 4-5.

Table 4-5 ATM T3, E3, and OC3 Interface Defaults

General Attributes	Default Value	Command
ATM clock	Receive clock	**atm clock internal** **no atm clock internal**
MTU size	4470 bytes	**mtu** *bytes* (64 to 9188)
T3 Attributes		
Line build-out	Short	**atm lbo** {**short** | **long**}
ATM DS3-scramble	Not enabled	**atm DS3-scramble** **no atm DS3-scramble**
ATM DS3 framing	cbitadm	**atm framing** {**m23plcp** | **cbitplcp** | **m23adm** | **cbitadm**}
E3 Attributes		
ATM E3-scramble	Not enabled	**atm e3-scramble** **no atm e3-scramble**
ATM E3 framing	G.832	**atm framing** {**g832adm** | **g751adm** | **g751plcp**}
OC3 Attributes		
SONET framing	sts-3c	**atm sonet stm-1** **no atm sonet stm-1**

Perform a basic interface configuration using the procedure below.

Note Additional configuration commands may be required, depending on your system requirements and the protocols you plan to route on the interface.

At any time, you can exit the privileged level and return to the user level by entering **disable** at the prompt as follows:

```
Router# disable
```

Note Information on configuring virtual circuits is described in the "Configuring ATM" chapter of the *Wide-Area Networking Configuration Guide* publication.

Step 1 At the `Router (config)#` prompt, enter the **interface** *type slot/port* command to enter the interface configuration mode. In this example, the serial port 0 is configured:

```
Router(config)# interface atm 1/0
Router(config-if)#
```

Enter any changes to the configuration.

Note To see a list of the configuration commands available to you, enter **?** at the prompt or press the **Help** key while in configuration mode.

Step 2 Specify the IP address. The following example uses an IP address of 10.1.1.50:

```
Router(config-if)# ip address 10.1.1.50 255.0.0.0
```

Step 3 Change the default settings or configure other features on the interface as needed. The following example shows you how to change the clock source to internal (the default is receive clock):

```
Router(config-if)# clock source internal
```

(See Table 4-5 for a list of commands used to change the default settings.)

Note For more information on configuring interfaces, refer to the *Cisco IOS Interface Configuration Guide* and the *Cisco IOS Interface Command Reference* publications. See "Related Documentation" section on page xi for more information.

Step 4 Enable the interface.

```
Router(config-if)# no shutdown
```

Step 5 Press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter.

Step 6 Save the new configuration to NVRAM as follows:

```
Router# copy running-config startup-config
[OK]
```

(See the "Saving the Running Configuration to NVRAM" section on page 4-17. Also see the "Checking the Interface Configurations" section on page 4-18 for examples of interface configurations.)

Your router is now minimally configured and will boot with the configuration you have entered.

Saving the Running Configuration to NVRAM

After you have completed configuring your router, enter the following command to store the configuration changes to your startup configuration in NVRAM so the router boots with the configuration you have entered:

```
Router# copy running-config startup-config
```

If you fail to save the configuration setting, your configuration will be lost the next time you reload the router.

Checking the Running Configuration Settings

Check your settings and review any changes to your configuration, using the commands below.

- Use the EXEC mode **show startup-config** command to display the information stored in NVRAM.
- Use the **show running-config** command to check the value of the settings you have entered before they are saved to NVRAM.

  The following example shows a sample output from the **show running-config** command:

```
Router# show running-config
Building configuration...

Current configuration:
!
version 12.0(6)T
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
no service dhcp
!
hostname Router
!
enable password egr
!

ip subnet-zero
ip host Router 10.0.0.0
ip host router 10.0.0.0
ip domain-name cisco.com
!
!
!

interface FastEthernet0/0
 ip address 10.0.0.0 255.0.0.0
 no ip directed-broadcast
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 10.0.0.0 255.255.0.0
 ip broadcast-address 255.255.0.0
 no ip directed-broadcast
 shutdown
 duplex auto
 speed auto
!
interface Serial1/0
```

```
 no ip address
 no ip directed-broadcast
 shutdown
 framing c-bit
 cablelength 10
 dsu bandwidth 44210
!
interface Serial1/1
 no ip address
 no ip directed-broadcast
 shutdown
 framing c-bit
 cablelength 10
 dsu bandwidth 44210
!
interface FastEthernet4/0
 no ip address
 no ip directed-broadcast
 shutdown
!
router igrp 200
 network 10.0.0.0
!
ip classless
no ip http server
!
!
map-list atm1
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

Checking the Interface Configurations

You can identify interfaces by using software commands:

- Use the **show interfaces** command to display information about all interfaces
- Use the **show interfaces** command with the interface type (Ethernet, Token Ring, ATM, and so forth), slot number, and port number in the format **show interfaces** *type slot*/*port* to display information about a specific interface

The following examples show the display for the Fast Ethernet port 0 in slot 0:

```
Router# show interfaces fastethernet 0/0
FastEthernet0/0 is up, line protocol is up
  Hardware is DEC21140A, address is 0050.73ff.6300 (bia 0050.73ff.6300)
  Internet address is 10.0.0.0
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
     reliablility 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Half-duplex, 10Mb/s, 100BaseTX/FX
  ARP type:ARPA, ARP Timeout 04:00:00
  Last input 00:00:04, output 00:00:03, output hang never
```

```
Last clearing of "show interface" counters never
Queueing strategy:fifo
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
5 minute input rate 2000 bits/sec, 1 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
   134 packets input, 41451 bytes
   Received 134 broadcasts, 0 runts, 0 giants, 0 throttles
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
   0 watchdog, 0 multicast
   0 input packets with dribble condition detected
   26 packets output, 5281 bytes, 0 underruns
   0 output errors, 0 collisions, 0 interface resets
   0 babbles, 0 late collision, 0 deferred
   0 lost carrier, 0 no carrier
   0 output buffer failures, 0 output buffers swapped out
```

Performing Other Configuration Tasks

Refer to the following publications to make advanced configuration changes after you establish the basic startup configuration for your router:

- *Cisco 7100 Series VPN Configuration Guide*; this document contains sample configurations.
- Modular configuration and modular command reference publications in the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware. These publications contain additional information on using the **configure** command.

  The configuration publications also provide information about the following tasks:

  - Understanding and working with the user interface on your router
  - Booting and rebooting the router
  - Setting the configuration register
  - Loading configuration files or system images using remote copy protocol (rcp) or Trivial File Transfer Protocol (TFTP)
  - Reloading the operating system

Viewing the System Configuration

Use the **show version** and the **show diag** commands to view information specific to the hardware configuration of your router.

Use the **show version** (or **show hardware**) command to display the system hardware (the network processing engine and number of interfaces installed), the software version, the names and sources of configuration files, and the boot images.

The following sample output of the **show version** command shows that the router is running Cisco IOS Release 12.0(4)XE:

```
Router# show version
Cisco Internetwork Operating System Software
IOS (tm) EGR Software (c7100-P-M), Released Version 12.0(4)XE
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Mon 07-Jun-99 17:49 by biff
Image text-base:0x600088F8, data-base:0x60A54000
```

```
ROM:System Bootstrap, Version 12.0(4)XE, RELEASED SOFTWARE
BOOTFLASH:EGR Software (c7100-BOOT-M), Released Version 12.0(1990607:041101)

Router uptime is 19 minutes
System restarted by reload
System image file is "c7100-p-mz"

cisco 7120-T3 (EGR) processor with 61440K/69632K bytes of memory.
R527x CPU at 225Mhz, Implementation 40, Rev 10.0, 2048KB L2 Cache
Last reset from power-on
X.25 software, Version 3.0.0.
3 FastEthernet/IEEE 802.3 interface(s)
1 Serial network interface(s)
125K bytes of non-volatile configuration memory.

4096K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2000
```

Use the **show diag** command to determine what types of port adapters are installed in the router. You can also use the **show diag** *slot* command to display information about a specific port adapter slot.

The following example shows the **show diag** command output from a Cisco 7120-T3:

```
Router# show diag
Slot 0:
        10/100 Fast-ethernet with RJ45 Integrated port adapter, 2 ports
        Integrated port adapter is analyzed
        EEPROM contents at hardware discovery:
        Hardware revision 1.0               Board revision A0
        EEPROM format version 1
        EEPROM contents (hex):
          0x20:01 D3 01 00 00 A4 19 EC 49 06 98 04 00 00 00 00
          0x30:50 00 00 00 98 10 21 00 FF FF FF FF FF FF FF FF

Slot 1:
        T3 PA Integrated port adapter, 1 port
        Integrated port adapter is analyzed
        EEPROM contents at hardware discovery:
        Hardware revision 1.0           Board revision A0
        EEPROM format version 1
        EEPROM contents (hex):
          0x20:01 70 01 00 00 BD 14 80 49 0A 38 02 00 00 00 00
          0x30:50 00 00 00 99 03 09 00 FF FF FF FF FF FF FF FF

Slot 3:
        Fast-ethernet (TX-ISL) Port adapter, 1 port
        Port adapter is analyzed
        Port adapter insertion time 00:20:37 ago
        EEPROM contents at hardware discovery:
        Hardware revision 1.0           Board revision A0
        Serial number     10754540      Part number    73-1688-04
        Test history      0x0           RMA number     00-00-00
        EEPROM format version 1
        EEPROM contents (hex):
          0x20:01 11 01 00 00 A4 19 EC 49 06 98 04 00 00 00 00
          0x30:50 00 00 00 98 10 21 00 FF FF FF FF FF FF FF FF
```

Use the **show c7100** command to show the contents of the EPROM. The **show c7100** command is used mainly for diagnostic purposes. Following is **show c7100** command sample output from a Cisco 7140-2T3:

```
Router# show c7100
Network IO Interrupt Throttling:
 throttle count=0, timer count=0
```

```
 active=0, configured=0
 netint usec=4000, netint mask usec=200

C7140-2T3 CPU EEPROM:
        Hardware revision 2.0           Board revision A0
        Serial number     11605417      Part number    73-FIXX-ME
        Test history      0x0           RMA number     00-00-00
        EEPROM format version 1
        EEPROM contents (hex):
          0x20:01 D4 02 00 00 B1 15 A9 49 0D 51 02 00 00 00 00
          0x30:50 00 00 00 98 12 30 00 00 00 FF FF FF FF FF 00

C7140-2T3 Extension EEPROM:
        MAC Address block size   :128
        Chassis MAC Address      :0050.73ff.6300
        Number of Slots          :1
        Model                    :7140-2T3
        Power Supply Type        :AC
        Platform features        :00 80 01 09 00 8E 00 16
                                    00 91 00 05
        EEPROM contents (hex):
          0x00:43 00 80 C3 06 00 50 73 FF 63 00 01 01 40 00 05
          0x10:CB 12 37 31 34 30 2D 32 54 33 00 00 00 00 37 31
          0x20:34 30 2D 32 0B 00 C9 0C 00 80 01 09 00 8E 00 16
          0x30:00 91 00 05 C7 1C 45 53 00 46 00 40 00 4B 00 48
          0x40:00 88 00 74 00 84 00 7F 00 84 00 84 00 00 00 00
          0x50:B8 97 FF FF FF FF FF FF FF FF FF FF FF FF FF FF

TLB entries :
Virt Address range      Phy Address range       Attributes
0x4B000000:0x4B1FFFFF   0x4B000000:0x4B1FFFFF   CacheMode=2, RW, Invalid
0x4B200000:0x4B3FFFFF   0x4B200000:0x4B3FFFFF   CacheMode=2, RW, Invalid
```

For specific information on the **show diag** and other software commands, refer to the modular configuration and modular command reference publications in the Cisco IOS software configuration documentation set that corresponds to the software release installed on your Cisco hardware.

Replacing or Recovering a Lost Password

It is possible to recover the enable or console login password. The enable secret password is encrypted, however, and must be replaced with a new enable secret password.

To replace or recover a lost password, see Chapter 5, “Troubleshooting the Installation.”

Overview of the Password Recovery Procedure

An overview of the password recovery procedure follows:

Step 1 Enter the **show version** command to determine the existing configuration register value if you can log in to the router.

Step 2 Press the **Break** key within 60 seconds to get to the bootstrap program prompt (ROM monitor). You might need to reload the system image by power cycling the router.

Step 3 Change the configuration register so the following functions are enabled: Break, ignore startup configuration, and boot from Flash memory.

Note The key to recovering a lost password is to set the configuration register bit 6 (0x0040) so that the startup configuration (usually in NVRAM) is ignored. This allows you to log in without using a password and to display the startup configuration passwords.

Step 4 Power cycle the router by turning power off and then back on.

Step 5 Log in to the router and enter the privileged EXEC mode.

Step 6 Enter the **show startup-config** command to display the passwords.

Step 7 Recover or replace the displayed passwords.

Step 8 Change the configuration register back to its original setting.

Note To recover a lost password if the Break function is disabled on the router, you must have physical access to the router.

Details of the Password Recovery Procedure

Complete the following steps to recover or replace a lost enable, enable secret, or console login password:

Step 1 Attach an ASCII terminal to the console port on your router.

Step 2 Configure the terminal to operate at 9600 baud, 8 data bits, no parity, and 2 stop bits.

Step 3 If you can log in to the router as a nonprivileged user, enter the **show version** command to display the existing configuration register value. Note the value for use later and proceed to Step 6. If you cannot log in to the router at all, go to the next step.

```
Router> show version
```

Step 4 Press the **Break** key or send a Break from the console terminal. If Break is enabled, the router enters the ROM monitor, indicated by the ROM monitor prompt (rommon1>). Proceed to Step 6. If Break is disabled, power cycle the router (turn the router off or unplug the power cord, and then restore power). Then proceed to Step 5.

Step 5 Within 60 seconds of restoring the power to the router, press the **Break** key or send a Break. This action causes the router to enter the ROM monitor and display the ROM monitor prompt (rommon1>).

Step 6 Set the configuration register using the configuration register utility—enter the **confreg** command at the ROM monitor prompt as follows:

```
rommon1> confreg
```

Step 7 Answer **yes** to the “enable ignore system config info?” question and note the current configuration register settings.

Step 8 Initialize the router by entering the **reset** command as follows:

```
rommon2> reset
```

The router initializes, the configuration register is set to 0x142, and the router boots the system image from Flash memory and enters the System Configuration Dialog (setup) as follows:

```
--- System Configuration Dialog --
```

Step 9 Enter **no** in response to the System Configuration Dialog prompts until the following message is displayed:

```
Press RETURN to get started!
```

Step 10 Press **Return**. The user EXEC prompt is displayed as follows:

```
Router>
```

Step 11 Enter the **enable** command to enter privileged EXEC (enable) mode. Then enter the **show startup-config** command to display the passwords in the configuration file as follows:

```
Router# show startup-config
```

Step 12 Scan the configuration file display looking for the passwords (the enable passwords are usually near the beginning of the file, and the console login or user EXEC password is near the end). The passwords displayed look something like this:

```
enable secret 5 $1$ORPP$s9syZt4uKn3SnpuLDrhuei
enable password 23skiddoo
.
.
line con 0
 password onramp
```

The enable secret password is encrypted and cannot be recovered; it must be replaced. The enable and console passwords may be encrypted or clear text. Proceed to the next step to replace an enable secret, console login, or enable password. If there is no enable secret password, note the enable and console login passwords, if they are not encrypted, and proceed to Step 16.

Caution *Do not* execute the next step unless you have determined you must change or replace the enable, enable secret, or console login passwords. Failure to follow the steps as shown might cause you to erase your router configuration.

Step 13 Enter the **configure memory** command to load the startup configuration file into running memory. This action allows you to modify or replace passwords in the configuration.

```
Router# configure memory
```

Step 14 Enter the privileged EXEC command **configure terminal** to enter configuration mode.

```
Hostname# configure terminal
```

Step 15 Change all three passwords using the following commands:

```
Hostname(config)# enable secret newpassword1
Hostname(config)# enable password newpassword2
Hostname(config)# line con 0
Hostname(config-line)# password newpassword3
```

Change only the passwords necessary for your configuration. You can remove individual passwords by using the **no** form of the above commands. For example, entering the **no enable secret** command removes the enable secret password.

Step 16 Configure all interfaces to be *not* administratively shut down as follows:

```
Hostname(config)# interface fastethernet 0/0
Hostname(config-if)# no shutdown
```

Caution Enter the equivalent commands for all interfaces that were originally configured. If you omit this step, all interfaces are administratively shut down and unavailable when the router is restarted.

Step 17 Use the **config-register** command to set the configuration register to the original value noted in Step 3 or Step 6, or to the factory default value 0x2102 as follows:

```
Hostname(config)# config-register 0x2102
```

Step 18 Press **Ctrl-Z** (hold down the **Control** key while you press **Z**) or enter **end** to exit configuration mode and return to the EXEC command interpreter.

Caution *Do not* execute the next step unless you have changed or replaced a password. If you skipped Step 12 throughStep 15, skip to Step 19. Failure to observe this caution causes you to erase your router configuration file.

Step 19 Enter the **copy running-config startup-config** command to save the new configuration to NVRAM.

Step 20 Enter the **reload** command to reboot the router.

Step 21 Log in to the router with the new or recovered passwords.

This completes the steps for recovering or replacing a lost enable, enable secret, or console login password.

Troubleshooting the Installation

Your Cisco 7100 series router went through extensive testing before leaving the factory. However, if you encounter problems starting the router, use the information in this chapter to help isolate the cause of the problems. This chapter contains the following sections:

- Troubleshooting Overview, page 5-1
- Troubleshooting the Power Subsystem, page 5-4
- Troubleshooting the Processor Subsystem, page 5-4
- Troubleshooting the Cooling Subsystem, page 5-6

These procedures assume that you are troubleshooting the initial system startup, and that your router is in the original factory configuration. If you have removed or replaced components or changed any default settings, the recommendations in this chapter might not apply. Review the safety warnings listed in the publication *Regulatory Compliance and Safety Information for Cisco 7100 Series VPN Routers* that accompanied your Cisco 7100 series router before using the troubleshooting procedures in this chapter.

Troubleshooting Overview

This section describes the troubleshooting methods used in this chapter and describes how Cisco 7100 series routers are divided into subsystems for more efficient problem solving.

Figure 5-1 shows the general troubleshooting strategy described in this chapter. Refer to this chart, as necessary, to follow the steps to isolate problems to a specific subsystem; then resolve the problem if possible.

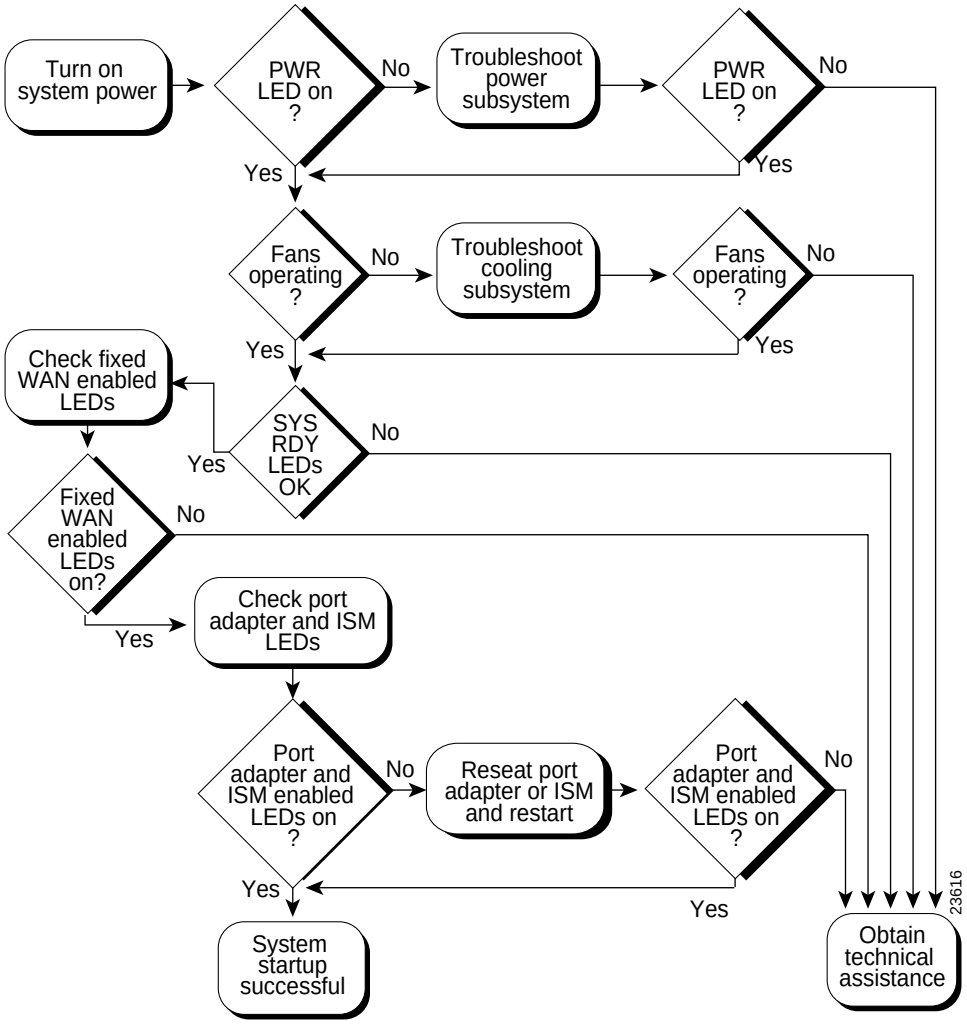
Before You Call for Technical Assistance

If you are unable to easily solve the problem, contact a customer service representative for assistance and further instructions. See "Obtaining Technical Assistance" section on page -xx for additional information. Provide the representative with the following information:

- Date you received the router
- Chassis serial number
- Type of software and release number
- Brief description of the problem you are having
- Brief explanation of the steps you have taken to isolate and resolve the problem

- Maintenance agreement or warranty information

Figure 5-1 Troubleshooting Strategy for Startup Problems



Problem Solving Using a Subsystems Approach

The key to solving problems with the system is isolating the problem to a specific subsystem. The first step in solving startup problems is to compare what the system *is doing* to what it *should be doing*. Because a startup problem is usually caused by a single component, it is more efficient to first isolate the problem to a subsystem rather than troubleshoot each component in the system. For these troubleshooting procedures, consider the following subsystems:

- Power subsystem—Includes the power supply and the external power cable.
- Processor subsystem—Includes the network processing card, the modular port adapter, the service module, and the fixed WAN ports. The system memory and management functions reside on the network processing card, and the enabled LED on each port indicates if the port is initialized. A modular port adapter that is partially installed in the router can cause the system to hang and crash.
- Cooling subsystem—Includes the fans.

The following sections help you isolate a problem to one of these subsystems and direct you to the appropriate troubleshooting section.

Identifying Startup Problems

Startup problems are commonly due to the source power or to a port adapter that is dislodged from the router. Although an over temperature condition is unlikely at initial startup, the environmental monitoring functions are included in this chapter because they also monitor internal voltages.

When you start the router for the first time, observe the startup sequence described in the "Starting the System and Observing Initial Conditions" section on page 4-1, which contains a more detailed description of the normal startup sequence.

LEDs indicate all system states in the startup sequence. Check the state of the LEDs to determine when and where the system failed in the startup sequence. Use the following descriptions to isolate the problem to a subsystem, and then proceed to the appropriate sections to try to resolve the problem.

When you start up the system by turning the power supply switch to the on (|) position, the following should occur:

- You should immediately hear the fans operating.

  If not, proceed to the "Troubleshooting the Cooling Subsystem" section on page 5-6. If you determine that the power supply is functioning normally and that a fan is faulty, contact a customer service representative. If a fan does not function properly at initial startup, there are no installation adjustments that you should make.

- The LEDs on the router should go on as follows:
  - The power LED goes on immediately and indicates that the router is receiving power. This LED goes on during a successful router boot and remains on during normal operation of the router.

    If this LED remains off when you start the router, either there is a problem with the power supply (it is damaged or not connected correctly), or the network processing card is not connected properly. Proceed to the "Troubleshooting the Power Subsystem" section on page 5-4.
  - The system ready LED goes on after the power LED and indicates that the network processor card is enabled for operation by the system; however, it does not mean that the Fast Ethernet port is functional or enabled. This LED goes on during a successful router boot and remains on during normal operation of the router.

If this LED remains off when you start the router, it is probably a problem with the network processor card. Contact your service representative for technical assistance.

- Each enabled LED goes on and indicates that the port is initialized and enabled for operation by the system. These LEDs go on during a successful router boot and remain on during normal operation of the router. If an enabled LED fails to go on, proceed to the "Troubleshooting the Port Adapter and Fixed WAN Ports" section on page 5-5.

  If any of the LEDs remain off when you start the router, it is probably a problem with the port. Proceed to the "Troubleshooting the Port Adapter and Fixed WAN Ports" section on page 5-5.

- The slot 0 and slot 1 LEDs only go on when the PC Card slot is being accessed by the system. These LEDs remain off during normal operation of the router and do not indicate startup problems.

- The initial system banner should be displayed on the console screen.

  If it is not displayed, see the "Connecting the Console Port and Auxiliary Port" section on page 3-16 to verify that the terminal is set up correctly and that it is properly connected to the router's console port.

Troubleshooting the Power Subsystem

Check the following to help isolate a problem with the power subsystem:

- Is the power LED on?
  - If yes, the power source is good, and the power supply is functional.
  - If no, make sure the power cable is connected at both ends.
  - If the power LED remains off, and the power switch is set correctly, suspect the power source or the power cable. Turn the switch off, connect the power cable to another power source, if available, and turn the switch back on. If the LED goes on, the problem is the first power source.
  - If the power LED fails to go on after you connect the power supply to a new power source, replace the power cord, and turn the switch back on. If the LED goes on, return the first power cable for replacement.
  - If the LED still fails to go on when the power supply is connected to a different power source with a new power cable, the power supply is probably faulty. Contact a service representative for further instructions.

Troubleshooting the Processor Subsystem

The processor subsystem comprises the network processing card and the ports. The system can operate without a port adapter installed as long as none are in *partial* contact with the connector pins. A port adapter that is partially connected to the router sends incomplete signals to the processor, which faults the Peripheral Component Interconnect (PCI) bus and causes the system to hang. Therefore, first ensure that the system software has initialized successfully. Then, if necessary, you can troubleshoot a port adapter.

Troubleshooting the Network Processor Card

The procedures in this section assume that the router is in the original factory configuration, and that you have not made changes to your configuration file.

If the system ready LED does not go on as expected (see the "Identifying Startup Problems" section on page 5-3), check the following items to help isolate the problem:

- Do all of the LEDs remain off when the system power switch is turned on?
  - If the LEDs stay off, first see the "Troubleshooting the Power Subsystem" section on page 5-4 and the "Troubleshooting the Cooling Subsystem" section on page 5-6 to ensure that both the fans and the power supply are functioning properly.
  - If the power supply and fans appear operational but the system ready or enable LEDs are off, suspect that an improperly connected port adapter has hung the system. Tighten all captive installation screws, and then restart the system.
- Is the system ready LED on?
  - If yes, the system software has initialized successfully, and the system is operational.
  - If the system ready LED remains off, the system detected a processor hardware failure. (This LED should be on in normal operation.) Contact a service representative for instructions.

Troubleshooting the Port Adapter and Fixed WAN Ports

Check the following to help isolate a problem with a port adapter or fixed WAN port:

- Are *all* enabled LEDs on?

  If yes, the system is operational.
- Are *any* enabled LEDs off?
  - If the enabled LED on a port adapter is off, suspect that the adapter has pulled away from the router. Reseat the adapter in its slot (you do not have to turn off the system power when removing or replacing port adapters). After the system reinitializes the interfaces, the enabled LED on the adapter should go on.
  - If the enabled LED on a fixed WAN port is off or if the port adapter's enabled LED remains off, the system detected a processor hardware failure. (This LED should be on in normal operation.) Contact a service representative for instructions.

Troubleshooting the Cooling Subsystem

Check the following to help isolate a problem with the cooling system:

- When you start up the system, do the fans start operating?

  To determine if the fans are operating, listen for them. In noisy environments, place your hand on the front of the chassis to feel for air being pushed out of the vents.

  - If yes, the power to the fans is good.
  - If no, there is a problem with the fan or power. (See the "Troubleshooting the Power Subsystem" section on page 5-4.)

- The following messages, if displayed, indicate that the system has detected a critical overtemperature condition or out-of-tolerance power inside the chassis:

```
Queued messages:

00:01:19:%ENVM-4-ENVWARN:+2.5 V measured at +2.59
00:01:19:%ENVM-4-ENVWARN:+5.15 V measured at +5.31

00:00:19:%ENVM-2-ENVCRIT:chassis core measured at 31C/87F
00:00:19:%ENVM-2-ENVCRIT:chassis inlet measured at 27C/80F
00:00:19:%ENVM-2-ENVCRIT:chassis outlet 1 measured at 30C/86F
00:00:19:%ENVM-2-ENVCRIT:chassis outlet 2 measured at 30C/86F
```

Although an overtemperature condition is unlikely at initial startup, ensure that heated exhaust air from other equipment is not entering the router's inlet vent, and that there is sufficient clearance around the sides of the chassis to allow cooling air to flow. (See the "Site Requirement Guidelines" section on page 2-6 for preventive site configurations.)

The above message could also indicate a faulty component or temperature sensor. Use the **show environment** or **show environment table** command to display the internal chassis environment. (See the "Displaying Environmental Status Reports" section on page 1-40 for descriptions of the **show environment** and **show environment table** commands.)

If you experience trouble with the startup that is not resolved with these procedures, manually power off the router and contact a service representative for assistance and
further instructions.

Modular Port Adapter Configuration Guidelines

The maximum recommended bandwidth points on each Peripheral Component Interconnect (PCI) bus is 600 points. For best performance we recommend that you avoid using port adapters that exceed the total available bandwidth for your router.

Table A-1 shows the modular port adapter bandwidth points available for each model and Table A-2 lists the port adapter bandwidth points.

Table A-1 Cisco 7100 Series PCI Bus Bandwidth Guidelines

Model	PCI Bus 0 Total Bandwidth Points Used (Slots 1, 3, 5)	PCI Bus 1 Total Bandwidth Points Used (Slots 0, 2, 4)	Bandwidth Points Available for Modular Port Adapter
7120-4T1	195 + port adapter	400	405
7120-T3	270 + port adapter	400	330
7120-E3	270 + port adapter	400	330
7120-AT3	270 + port adapter	400	330
7120-AE3	270 + port adapter	400	330
7120-SMI3	270 + port adapter	400	330
7140-2T3	360	400 + port adapter	200
7140-8T	195	415 + port adapter	185
7140-2FE	180	400 + port adapter	200
7140-2E3	360	400 + port adapter	200
7140-2AT3	270	490 + port adapter	110

Note For the Cisco 7140-2MM3, we recommend that you use port ATM 1/0 as your primary interface and port ATM 2/0 as your backup interface.

Table A-2 Cisco 7100 Series Modular Port Adapter Bandwidth Specifications

Port Adapter Type	Product Name	Bandwidth Points
ATM		
1-port multimode	PA-A1-OC3MM	300
1-port single-mode intermediate reach	PA-A1-OC3SMI	
Enhanced	PA-A3-T3	90
	PA-A3-E3	
	PA-A3-OC3MM	300
	PA-A3-OC3SMI	
	PA-A3-OC3SML	
ISDN		
4- and 8-port Basic Rate Interface (BRI) ISDN	PA-4B-U	–
	PA-8B-ST	
Fast Ethernet and Ethernet		
8-port Ethernet 10BaseT	PA-8E	80
5-port Ethernet 10BaseFL	PA-5EFL	50
4-port Ethernet 10BaseT	PA-4E	40
2-port Fast Ethernet/ISL 100BaseTX	PA-2FEISL-TX	300
2-port Fast Ethernet/ISL 100BaseFX	PA-2FEISL-FX	
1-port Fast Ethernet 100BaseTX	PA-FE-TX	200
1-port Fast Ethernet 100BaseFX	PA-FE-FX	
Serial		
1-port high-speed serial	PA-H (Rev. B)	100
2-port high-speed serial	PA-2H (Rev. B)	200
1-port E3 high-speed serial	PA-E3	90
1-port T3 high-speed serial	PA-T3	
1-port T3+ high-speed serial	PA-T3+	
2-port E3 high-speed serial	PA-2E3	180
2-port T3 high-speed serial	PA-2T3	
2-port T3+ high-speed serial	PA-2T3+	
8-port synchronous serial (X.21)	PA-8T-X21	–
8-port synchronous serial (V.35)	PA-8T-V35	
8-port synchronous serial (EIA/TIA-232)	PA-8T-232	
4-port synchronous serial, enhanced	PA-4T+	–

Table A-2 Cisco 7100 Series Modular Port Adapter Bandwidth Specifications (continued)

Port Adapter Type	Product Name	Bandwidth Points
Special adapters		
Integrated Service Module (ISM)	SM-EC-DES	180
	SM-EC-3DES	
Token Ring		
4-port dedicated Token Ring	PA-4R-DTR	120

System Specifications

Table B-1 Physical Specifications and Power Requirements

Description	Specifications
Dominions (H x W x D)	3.5 in. x 17.5 in. x 18.25 in. (8.89 cm x 44.45 cm x 46.36 cm)
Weight	~ 32 lb (14.5 kg)
Heat dissipation	370W (1262 Btu[1])
Input voltage, AC power supply Current Frequency Power factor Input AC power	100 to 240 VAC 5 to 2.5A[2] 50/60 Hz 0.80 to 0.95 525W[3] (maximum)
AC-input cable(s)	18-AWG[4] 3-wire cable, with a 3-lead IEC-320 receptacle on the power supply end, and a country-dependent plug on the power source end
Airflow	~120 cfm[5]
Temperature	32 to 104°F (0 to 40°C) operating; –4 to 149°F (–20 to 65°C) nonoperating
Humidity	10 to 90% noncondensing
LAN interfaces	2 Ethernet 10BaseT/100BaseTX autosensing (RJ-45)
Console and auxiliary ports	Asynchronous serial (RJ-45)
WAN interface options	T1/E1, T3, E3, ATM T3, ATM E3, and ATM OC-3c/STM1 single-mode intermediate reach and multimode
Recommended minimum software requirements	Cisco IOS Release 12.0(4)XE or later releases of 12.0 XE Cisco IOS Release 12.0(6)T or later releases of 12.0 T
Compliance	CE Marking, FCC Part 68
Safety	UL 1950, CSA 22.2 No. 950, EN60950, AUSTEL TS001, AS/NZS 3260, IEC 950
EMC[6]	FCC Class A (47 CFR, Part 15), ICES-003 Class A, EN55022 Class B, CISPR22 Class B, AS/NZS 3548 Class B, and VCCI Class B

1. Btu = British thermal units.
2. A = amperes.
3. W = watts.

4. AWG = American Wire Gauge.
5. cfm = cubic feet per minute.
6. EMC = electromagnetic compliance.

Cable Specifications

This appendix provides the following cabling and pinout information for the Cisco 7100 series routers:

- Console and Auxiliary Port Cables and Pinouts, page C-1
- Fast Ethernet Port Cables and Pinouts, page C-4
- Cisco 7120-4T1 and Cisco 7140-8T Cables and Pinouts, page C-5
- Cisco 7120-T3, Cisco 7120-E3, Cisco 7140-2T3, and Cisco 7140-2E3 Cables, page C-18
- Cisco 7120-AT3, Cisco 7140-2AT3, Cisco 7120-AE3, Cisco 7140-2AE3, Cisco 7120-SMI3, and Cisco 7140-2MM3 Cables, page C-19

Note This appendix specifies pinouts only for the pins used. Pins not listed in the tables in this appendix are not connected.

Console and Auxiliary Port Cables and Pinouts

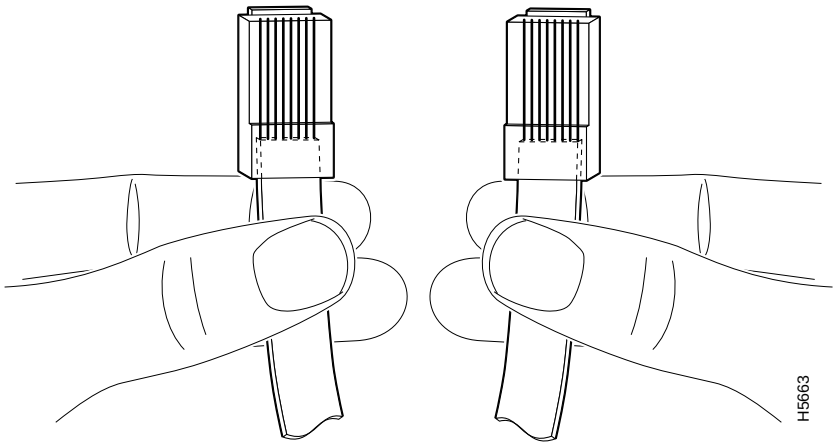
The router arrives with a console and auxiliary cable kit, which contains the cable and adapters you need to connect a console (an ASCII terminal or PC running terminal emulation software) or modem to the router. The console and auxiliary cable kit includes:

- RJ-45-to-RJ-45 rollover cable
- RJ-45-to-DB-9 female data terminal equipment (DTE) adapter labeled TERMINAL
- RJ-45-to-DB-25 female DTE adapter labeled TERMINAL
- RJ-45-to-DB-25 male data communications equipment (DCE) adapter labeled MODEM

Identifying a Rollover Cable

You can identify a rollover cable by comparing the two modular ends of the cable. Holding the cables side-by-side, with the tab at the back, the wire connected to the pin on the outside of the left plug should be the same color as the wire connected to the pin on the outside of the right plug. (See Figure C-1.) If your cable was purchased from Cisco Systems, pin 1 will be white on one connector, and pin 8 will be white on the other connector (a rollover cable reverses pins 1 and 8, 2 and 7, 3 and 6, and 4 and 5).

Figure C-1 Identifying a Rollover Cable



Console Port Cables and Pinouts

Use the RJ-45-to-RJ-45 rollover cable and RJ-45-to-DB-9 female DTE adapter (labeled TERMINAL) to connect the console port to a PC running terminal emulation software. Table C-1 lists the signals and pinouts for the asynchronous serial console port, the RJ-45-to-RJ-45 rollover cable, and the RJ-45-to-DB-9 female DTE adapter (labeled TERMINAL).

Table C-1 Console Port Signaling and Cabling Using a DB-9 Adapter

Console Port (DTE)	RJ-45-to-RJ-45 Rollover Cable		RJ-45-to-DB-9 Terminal Adapter	Console Device
Signal	**RJ-45 Pin**	**RJ-45 Pin**	**DB-9 Pin**	**Signal**
RTS	1[1]	8	8	CTS
DTR	2	7	6	DSR
TxD	3	6	2	RxD
GND	4	5	5	GND
GND	5	4	5	GND
RxD	6	3	3	TxD
DSR	7	2	4	DTR
CTS	8[1]	1	7	RTS

1. Pin 1 is connected internally to pin 8.

Use the RJ-45-to-RJ-45 rollover cable and RJ-45-to-DB-25 female DTE adapter (labeled TERMINAL) to connect the console port to a terminal. Table C-2 lists the signals and pinouts for the asynchronous serial console port, the RJ-45-to-RJ-45 rollover cable, and the RJ-45-to-DB-25 female DTE adapter (labeled TERMINAL).

Table C-2 Console Port Signaling and Cabling Using a DB-25 Adapter

Console Port (DTE)[1]	RJ-45-to-RJ-45 Rollover Cable		RJ-45-to-DB-25 Terminal Adapter	Console Device
Signal	**RJ-45 Pin**	**RJ-45 Pin**	**DB-25 Pin**	**Signal**
RTS	1[2]	8	5	CTS
DTR	2	7	6	DSR
TxD	3	6	3	RxD
GND	4	5	7	GND
GND	5	4	7	GND
RxD	6	3	2	TxD
DSR	7	2	20	DTR
CTS	8[1]	1	4	RTS

1. You can use the same cabling to connect a console to the auxiliary port.
2. Pin 1 is connected internally to pin 8.

Auxiliary Port Cables and Pinouts

Use the RJ-45-to-RJ-45 rollover cable and RJ-45-to-DB-25 male DCE adapter (labeled MODEM) to connect the auxiliary port to a modem. Table C-3 lists the signals and pinouts for the asynchronous serial auxiliary port, the RJ-45-to-RJ-45 rollover cable, and the RJ-45-to-DB-25 male DCE adapter (labeled MODEM).

Table C-3 Auxiliary Port Signaling and Cabling Using a DB-25 Adapter

AUX Port (DTE)	RJ-45-to-RJ-45 Rollover Cable		RJ-45-to-DB-25 Modem Adapter	Modem (DCE)
Signal	**RJ-45 Pin**	**RJ-45 Pin**	**DB-25 Pin**	**Signal**
RTS	1	8	4	RTS
DTR	2	7	20	DTR
TxD	3	6	3	TxD
GND	4	5	7	GND
GND	5	4	7	GND
RxD	6	3	2	RxD
DSR	7	2	8	DCD
CTS	8	1	5	CTS

Fast Ethernet Port Cables and Pinouts

The 10BaseT/100BaseTX Fast Ethernet ports support IEEE 802.3 and IEEE 802.3u specifications for 10-Mbps and 100-Mbps transmission over unshielded twisted-pair (UTP) cables. Each Fast Ethernet port on the router has an RJ-45 connector to attach to Category 3 or Category 5 UTP cables.

Cisco Systems does not supply Category 3 or Category 5 UTP RJ-45 cables; these cables are available commercially.

Use a Category 3 UTP crossover cable when connecting 10BaseT port to a hub or use a Category 3 UTP straight-through cable when connecting to an end station.

Use a Category 5 UTP crossover cable when connecting 100BaseTX to a hub or use a Category 5 UTP straight-through cable when connecting to an end station.

To determine the type of RJ-45 cable, examine the sequence of colored wires as follows:

- Straight-through—Colored wires are in the same sequence at both ends of the cable.
- Crossover—The first (far left) colored wire at one end of the cable is the third colored wire at the other end of the cable, and the second colored wire at one end of the cable is the sixth colored wire at the other end of the cable.

Table C-4 lists the 10BaseT pinouts and Table C-5 lists the 100BaseTX pinouts for the two Fast Ethernet ports.

Table C-4 10BaseT RJ-45 Connector Pinouts

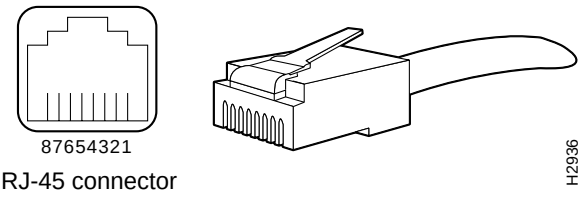
RJ-45 Pin	Description
1	Tx+
2	Tx–
3	Rx+
6	Rx–

Table C-5 100BaseTX RJ-45 Connector Pinouts

RJ-45 Pin	Description
1	Tx+
2	Tx–
3	Rx+
6	Rx–

Figure C-2 shows the RJ-45 cable connectors.

Figure C-2 RJ-45 Plug and Receptacle



Cisco 7120-4T1 and Cisco 7140-8T Cables and Pinouts

The four T1 ports on the Cisco 7120-4T1 and the eight T1 ports on the Cisco 7140-8T and adapter cables allow a high density of interface ports, regardless of the size of the connectors typically used with each electrical interface type. All ports use an identical 60-pin D-shell receptacle that supports all interface types:

- EIA/TIA-232
- V.35
- EIA/TIA-449
- X.21
- EIA-530

Each port requires a serial adapter cable, which provides the interface between the high-density serial port and the standard connectors that are commonly used for each electrical interface type.

Note The adapter cable determines the electrical interface type and mode of the port (DTE or DCE) to which it is connected.

The network end of the cable is an industry-standard connector for the type of electrical interface that the cable supports. For most interface types, the adapter cable for DTE mode uses a plug at the network end, and the cable for DCE mode uses a receptacle at the network end. Exceptions are V.35 adapter cables, which are available with either a V.35 plug or a receptacle for either mode, and the EIA-530 adapter cable, which is available only in DTE mode with a DB-25 plug at the network end. The mode is labeled on the molded plastic connector shell at the ends of all cables except V.35 (which uses the standard Winchester block-type connector instead of a molded plastic D shell).

Caution Serial interface cables must be attached correctly, or damage to the cable plug will result. Attempting to force a cable plug on the 60-pin receptacle can damage the plug. (See Figure C-3.)

Figure C-3 Correct Serial Cable Orientation

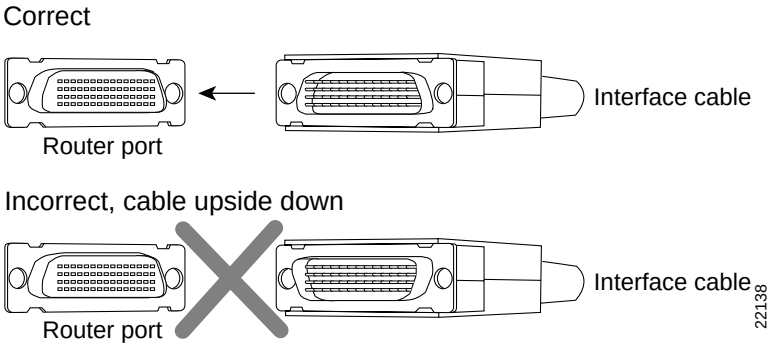


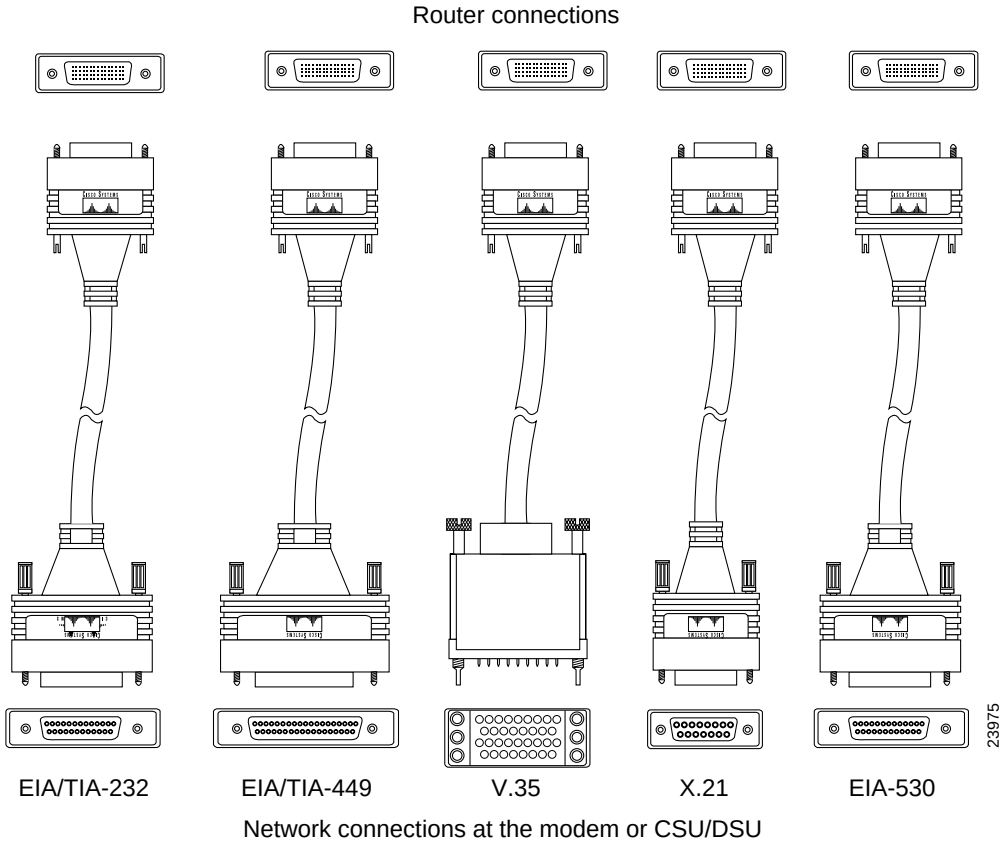
Table C-6 lists the available interface cable options (and product numbers) for the mode and network-end connectors.

Table C-6 Serial Cable Product Numbers

Interface Type	Description	Product Number
EIA/TIA-232	DTE mode with a DB-25 plug	CAB-232MT=
	DCE mode with a DB-25 receptacle	CAB-232FC=
EIA/TIA-449	DTE mode with a 37-pin D-shell plug	CAB-449MT=
	DCE mode with a 37-pin D-shell receptacle	CAB-449C=
V.35	DTE mode or DCE mode with a 34-pin Winchester-type V.35 plug	CAB-V35MT= or CAB-V35MC=
	DTE mode or DCE mode with a 34-pin Winchester-type V.35 receptacle	CAB-V35FT= or CAB-V35FC=
	Male DB-60 plug on the router end and a male DB-34 shielded plug on the network end	CAB-V35MTS=
X.21	DTE mode with a DB-15 plug	CAB-X21MT=
	DCE mode with a DB-25 receptacle	CAB-X21FC=
EIA-530	DTE mode with a DB-25 plug	CAB-530MT=

Figure C-4 shows the supported serial cables.

Figure C-4 T1 Serial Cables



Metric (M3) thumbscrews are included with each cable to allow connections to devices that use metric hardware. Because the T1 ports use a special, high-density port that requires special adapter cables for each electrical interface type, we recommend that you obtain serial interface cables from the factory.

Serial signals can travel a limited distance at any given bit rate; generally, the slower the baud rate, the greater the distance. All serial signals are subject to distance limits beyond which a signal degrades significantly or is completely lost.

Table C-7 lists the recommended (standard) maximum speeds and distances for each serial interface type. The recommended maximum rate for V.35 is 2.048 Mbps.

Table C-7 Recommended (Standard) Maximum Speeds and Distances for Serial Interfaces

	EIA/TIA-232 Distances		EIA/TIA-449, X.21, V.35, EIA-530 Distances	
Rate (bps)	**Feet**	**Meters**	**Feet**	**Meters**
2400	200	60	4,100	1,250
4800	100	30	2,050	625
9600	50	15	1,025	312
19200	25	7.6	513	156
38400	12	3.7	256	78

Table C-7 Recommended (Standard) Maximum Speeds and Distances for Serial Interfaces (continued)

	EIA/TIA-232 Distances		EIA/TIA-449, X.21, V.35, EIA-530 Distances	
56000	8.6	2.6	102	31
1544000 (T1)	–	–	50	15

Balanced drivers allow EIA/TIA-449 signals to travel greater distances than EIA/TIA-232 signals. The recommended distance limits for EIA/TIA-449 shown in Table C-7 are also valid for V.35, X.21, and EIA-530. EIA/TIA-449 and EIA-530 support 2.048-Mbps rates, and V.35 supports 2.048-Mbps rates without any problems; we do not recommend exceeding published specifications for transmission speed versus distance. Do so at your own risk.

EIA/TIA-232 Connections

The router end of all EIA/TIA-232 adapter cables is a high-density 60-pin plug. The network end of the adapter cable is a standard 25-pin D-shell connector (known as a DB-25) that is commonly used for EIA/TIA-232 connections. Figure C-5 shows the connectors at the network end of the adapter cable.

Do not use the Cisco Systems-provided EIA/TIA-232 adapter cable product number CAB-232MT= to connect a T1 interface that is configured for DTE mode *directly* to an NEC - NEXTSTAR 1E model C4969 MD/SAC unit interface that is configured for DCE mode. Doing so will keep transmit and receive data signals from being properly exchanged between the two interfaces.

Instead, you must connect an additional, intermediate adapter cable—with standard EIA/TIA-232 DB-25 connectors at both ends—from the network end of product number CAB-232MT= to the standard EIA/TIA-232 DB-25 connector (the DCE interface) on the NEC - NEXTSTAR 1E model C4969 MD/SAC unit. Cisco Systems does not provide this additional cable; however, its signals and pin assignments are listed in Table C-8.

You can use the Cisco Systems-provided EIA/TIA-232 adapter cable product number CAB-232FC= to connect a T1 interface that is configured for DCE mode *directly* to an NEC - NEXTSTAR 1E model C4969 MD/SAC unit interface that is configured for DTE mode. This cable's pin assignments are listed in Table C-9.

Figure C-5 EIA/TIA-232 Adapter Cable Connectors

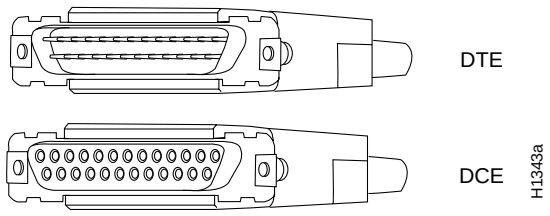


Table C-8 EIA/TIA-232 Adapter Cable Signals (DTE)

DTE Cable (CAB-232MT=)				
Router End, HD[1] 60-Position Plug				Network End, DB-25 Plug
Signal	Pin		Pin	Signal

Table C-8 EIA/TIA-232 Adapter Cable Signals (DTE) (continued)

DTE Cable (CAB-232MT=)				
Shield ground	46	–	1	Shield ground
TxD/RxD	41	—>	2	TxD
RxD/TxD	36	<—	3	RxD
RTS/CTS	42	—>	4	RTS
CTS/RTS	35	<—	5	CTS
DSR/DTR	34	<—	6	DSR
Circuit ground	45	–	7	Circuit ground
DCD/LL	33	<—	8	DCD
TxC/NIL	37	<—	15	TxC
RxC/TxCE	38	<—	17	RxC
LL/DCD	44	—>	18	LTST
DTR/DSR	43	—>	20	DTR
TxCE/TxC	39	—>	24	TxCE
Mode 0 Ground Mode_DCE	50 51 52	–	–	Shorting group

1. HD = high-density.

Table C-9 EIA/TIA-232 Adapter Cable Signals (DCE)

DCE Cable (CAB-232FC=)				
Router End, HD[1] 60-Position Plug				**Network End, DB-25 Receptacle**
Signal	**Pin**		**Pin**	**Signal**
Shield ground	46	–	1	Shield ground
RxD/TxD	36	<—	2	TxD
TxD/RxD	41	—>	3	RxD
CTS/RTS	35	<—	4	RTS
RTS/CTS	42	—>	5	CTS
DTR/DSR	43	—>	6	DSR
Circuit ground	45	–	7	Circuit ground
LL/DCD	44	—>	8	DCD
TxCE/TxC	39	—>	15	TxC
NIL/RxC	40	—>	17	RxC
DCD/LL	33	<—	18	LTST
DSR/DTR	34	<—	20	DTR

Table C-9 EIA/TIA-232 Adapter Cable Signals (DCE) (continued)

DCE Cable (CAB-232FC=)				
RxC/TxCE	38	<—	24	TxCE
Mode 0 Ground	50 51	–	–	Shorting group

1. HD = high-density.

EIA/TIA-449 Connections

The router end of all EIA/TIA-449 adapter cables is a high-density 60-pin plug. The network end of the adapter cable provides a standard 37-pin D-shell connector, which is commonly used for EIA/TIA-449 connections. Figure C-6 shows the connectors at the network end of the adapter cable. EIA/TIA-449 cables are available as either DTE (DB-37 plug) or DCE (DB-37 receptacle). See Table C-10 and Table C-11 for pinouts.

Figure C-6 EIA/TIA-449 Adapter Cable Connectors

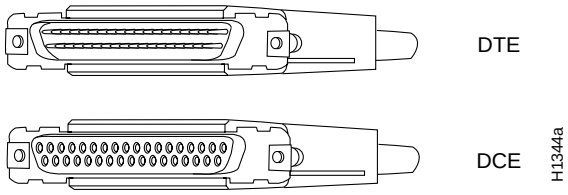


Table C-10 EIA/TIA-449 Adapter Cable Signals (DTE)

DTE Cable (CAB-449MT=)				
Router End, HD[1] 60-Position Plug				**Network End, DB-37 Plug**
Signal	**Pin**		**Pin**	**Signal**
Shield ground	46	–	1	Shield ground
TxD/RxD+	11	—>	4	SD+
TxD/RxD–	12	—>	22	SD–
TxC/RxC+	24	<—	5	ST+
TxC/RxC–	23	<—	23	ST–
RxD/TxD+	28	<—	6	RD+
RxD/TxD–	27	<—	24	RD–
RTS/CTS+	9	—>	7	RS+
RTS/CTS–	10	—>	25	RS–
RxC/TxCE+	26	<—	8	RT+
RxC/TxCE–	25	<—	26	RT–
CTS/RTS+	1	<—	9	CS+
CTS/RTS–	2	<—	27	CS–

Table C-10 EIA/TIA-449 Adapter Cable Signals (DTE) (continued)

DTE Cable (CAB-449MT=)				
LL/DCD	44	—>	10	LL
Circuit ground	45	–	37	SC
DSR/DTR+	3	<—	11	ON+
DSR/DTR–	4	<—	29	ON–
DTR/DSR+	7	—>	12	TR+
DTR/DSR–	8	—>	30	TR–
DCD/DCD+	5	<—	13	RR+
DCD/DCD–	6	<—	31	RR–
TxCE/TxC+	13	—>	17	TT+
TxCE/TxC–	14	—>	35	TT–
Circuit ground	15	–	19	SG
Circuit ground	16	–	20	RC
Mode 1 Ground	49 48	–	–	Shorting group
Ground Mode_DCE	51 52	–	–	Shorting group

1. HD = high-density.

Table C-11 EIA/TIA-449 Adapter Cable Signals (DCE)

DCE Cable (CAB-449C=)				
Router End, HD[1] 60-Position Plug				**Network End, DB-37 Receptacle**
Signal	**Pin**		**Pin**	**Signal**
Shield ground	46	–	1	Shield ground
RxD/TxD+	28	<—	4	SD+
RxD/TxD–	27	<—	22	SD–
TxCE/TxC+	13	—>	5	ST+
TxCE/TxC–	14	—>	23	ST–
TxD/RxD+	11	—>	6	RD+
TxD/RxD–	12	—>	24	RD–
CTS/RTS+	1	<—	7	RS+
CTS/RTS–	2	<—	25	RS–
TxC/RxC+	24	—>	8	RT+
TxC/RxC–	23	—>	26	RT–
RTS/CTS+	9	—>	9	CS+
RTS/CTS–	10	—>	27	CS–

Table C-11 EIA/TIA-449 Adapter Cable Signals (DCE) (continued)

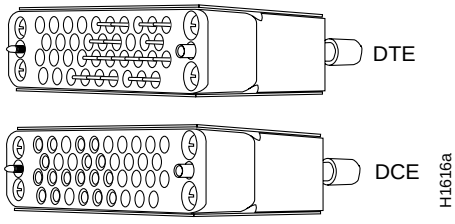
DCE Cable (CAB-449C=)				
NIL/LL	29	—>	10	LL
Circuit ground	30	–	37	SC
DTR/DSR+	7	—>	11	ON+
DTR/DSR–	8	—>	29	ON–
DSR/DTR+	3	<—	12	TR+
DSR/DTR–	4	<—	30	TR–
DCD/DCD+	5	—>	13	RR+
DCD/DCD–	6	—>	31	RR–
RxC/TxCE+	26	<—	17	TT+
RxC/TxCE–	25	<—	35	TT–
Circuit ground	15	–	19	SG
Circuit ground	16	–	20	RC
Mode 1 Ground	49 48	–	–	Shorting group

1. HD = high-density.

V.35 Connections

The router end of all V.35 adapter cables is a high-density 60-pin plug. The network end of the adapter cable provides a standard 34-pin Winchester-type connector commonly used for V.35 connections. Figure C-7 shows the connectors at the network end of the V.35 adapter cable. V.35 cables are available with a standard V.35 plug for DTE mode (CAB-V35MT=) or a V.35 receptacle for DCE mode (CAB-V35FC=). See Table C-12 and Table C-13 for pinouts.

Figure C-7 V.35 Adapter Cable Connectors



Also available, but not shown in Figure C-7, are CAB-V35MC=, a V.35 cable with a plug on the network end for DCE mode, and CAB-V35FT=, a V.35 cable with a receptacle on the network end for DTE mode. These cables are used for connecting V.35-equipped systems back to back.

Table C-12 V.35 Adapter Cable Signals (DTE)

DTE Cable (CAB-V35FT= or CAB-V35MT=)				
Router End, HD[1] 60-Position Plug				**Network End, 34-Position Plug**
Signal	**Pin**		**Pin**	**Signal**
Shield ground	46	–	A	Frame ground
Circuit ground	45	–	B	Circuit ground
RTS/CTS	42	—>	C	RTS
CTS/RTS	35	<—	D	CTS
DSR/DTR	34	<—	E	DSR
DCD/LL	33	<—	F	RLSD
DTR/DSR	43	—>	H	DTR
LL/DCD	44	—>	K	LT
TxD/RxD+	18	—>	P	SD+
TxD/RxD–	17	—>	S	SD–
RxD/TxD+	28	<—	R	RD+
RxD/TxD–	27	<—	T	RD–
TxCE/TxC+	20	—>	U	SCTE+
TxCE/TxC–	19	—>	W	SCTE–
RxC/TxCE+	26	<—	V	SCR+
RxC/TxCE–	25	<—	X	SCR–
TxC/RxC+	24	<—	Y	SCT+
TxC/RxC–	23	<—	AA	SCT–
Mode 1 Ground	49 48	–	–	Shorting group
Mode 0 Ground Mode_DCE	50 51 52	–	–	Shorting group
TxC/NIL RxC/TxCE RxC/TxD Ground	53 54 55 56	–	–	Shorting group

1. HD = high-density.

Table C-13 V.35 Adapter Cable Signals (DCE)

DCE Cable (CAB-V35FC= or CAB-V35MC=)				
Router End, HD[1] 60-Position Plug				**Network End, 34-Position Receptacle**
Signal	**Pin**		**Pin**	**Signal**

Table C-13 V.35 Adapter Cable Signals (DCE) (continued)

DCE Cable (CAB-V35FC= or CAB-V35MC=)				
Shield ground	46	–	A	Frame ground
Circuit ground	45	–	B	Circuit ground
CTS/RTS	35	<—	C	RTS
RTS/CTS	42	—>	D	CTS
DTR/DSR	43	—>	E	DSR
LL/DCD	44	—>	F	RLSD
DSR/DTR	34	<—	H	DTR
DCD/LL	33	<—	K	LT
RxD/TxD+	28	<—	P	SD+
RxD/TxD–	27	<—	S	SD–
TxD/RxD+	18	—>	R	RD+
TxD/RxD–	17	—>	T	RD–
RxC/TxCE+	26	<—	U	SCTE+
RxC/TxCE–	25	<—	W	SCTE–
NIL/RxC+	22	—>	V	SCR+
NIL/RxC–	21	—>	X	SCR–
TxCE/TxC+	20	—>	Y	SCT+
TxCE/TxC–	19	—>	AA	SCT–
Mode 1 Ground	49 48	–	–	Shorting group
Mode 0 Ground	50 51	–	–	Shorting group
TxC/NIL RxC/TxCE RxC/TxD Ground	53 54 55 56	–	–	Shorting group

1. HD = high-density.

X.21 Connections

The router end of all X.21 adapter cables is a high-density 60-pin plug. The network end of the adapter cable is a standard DB-15 connector. Figure C-8 shows the connectors at the network end of the X.21 adapter cable. X.21 cables are available as either DTE (DB-15 plug) or DCE (DB-15 receptacle). See Table C-14 and Table C-15 for pinouts.

Figure C-8 X.21 Adapter Cable Connectors

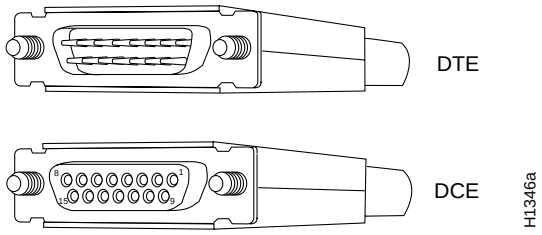


Table C-14 X.21 Adapter Cable Signals (DTE)

DTE Cable (CAB-X21MT=)				
Router End, HD[1] 60-Position Plug				**Network End, DB-15 Plug**
Signal	**Pin**		**Pin**	**Signal**
Shield ground	46	–	1	Shield ground
TxD/RxD+	11	—>	2	Transmit+
TxD/RxD–	12	—>	9	Transmit–
RTS/CTS+	9	—>	3	Control+
RTS/CTS –	10	—>	10	Control–
RxD/TxD+	28	<—	4	Receive+
RxD/TxD–	27	<—	11	Receive–
CTS/RTS+	1	<—	5	Indication+
CTS/RTS –	2	<—	12	Indication–
RxC/TxCE+	26	<—	6	Timing+
RxC/TxCE–	25	<—	13	Timing–
Circuit ground	15	–	8	Circuit ground
Ground Mode_2	48 47	–	–	Shorting group
Ground Mode_DCE	51 52	–	–	Shorting group

1. HD = high-density.

Table C-15 X.21 Adapter Cable Signals (DCE)

DCE Cable (CAB-X21FC=)				
Router End, HD[1] 60-Position Plug				**Network End, DB-15 Receptacle**
Signal	**Pin**		**Pin**	**Signal**
Shield ground	46	–	1	Shield ground
RxD/TxD+	11	—>	2	Transmit+
RxD/TxD–	12	—>	9	Transmit–
CTS/RTS+	9	—>	3	Control+
CTS/RTS –	10	—>	10	Control–
TxD/RxD+	28	<—	4	Receive+
TxD/RxD–	27	<—	11	Receive–
RTS/CTS+	1	<—	5	Indication+
RTS/CTS–	2	<—	12	Indication–
TxC/RxC+	26	<—	6	Timing+
TxC/RxC –	25	<—	13	Timing–
Circuit ground	15	–	8	Circuit ground
Ground Mode_2	48 47	–	–	Shorting group
Ground Mode_DCE	51 52	–	–	–

1. HD = high-density.

EIA-530 Connections

The EIA-530 adapter cable is available in DTE mode only. The router end of the EIA-530 adapter cable is a high-density 60-pin plug. The network end of the adapter cable is a standard DB-25 plug commonly used for EIA/TIA-232 connections. Figure C-9 shows the DB-25 connector at the network end of the adapter cable.

Figure C-9 EIA-530 Adapter Cable Connector

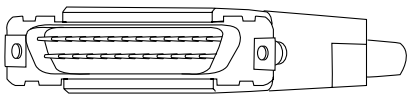


Table C-16 EIA-530 DTE Adapter Cable Signals (CAB-530MT=)

Router End, HD[1] 60-Position Plug				**Network End, DB-25 Plug**
Signal	**Pin**		**Pin**	**Signal**
Shield ground	46	–	1	Shield ground

Table C-16 EIA-530 DTE Adapter Cable Signals (CAB-530MT=)

Router End, HD[1] 60-Position Plug				Network End, DB-25 Plug
TxD/RxD+	11	—>	2	TxD+
TxD/RxD–	12	—>	14	TxD–
RxD/TxD+	28	<—	3	RxD+
RxD/TxD–	27	<—	16	RxC–
RTS/CTS+	9	—>	4	RTS+
RTS/CTS–	10	—>	19	RTS–
CTS/RTS+	1	<—	5	CTS+
CTS/RTS–	2	<—	13	CTS–
DSR/DTR+	3	<—	6	DSR+
DSR/DTR–	4	<—	22	DSR–
DCD/DCD+	5	<—	8	DCD+
DCD/DCD–	6	<—	10	DCD–
TxC/RxC+	24	<—	15	TxC+
TxC/RxC–	23	<—	12	TxC–
RxC/TxCE+	26	<—	17	RxC+
RxC/TxCE–	25	<—	9	RxC–
LL/DCD	44	—>	18	LL
Circuit ground	45	–	7	Circuit ground
DTR/DSR+	7	—>	20	DTR+
DTR/DSR–	8	—>	23	DTR–
TxCE/TxC+	13	—>	24	TxCE+
TxCE/TxC–	14	—>	11	TxCE–
Mode_1 Ground Mode_2	49 48 47	–	–	Shorting group
Ground Mode_DCE	51 52	–	–	Shorting group

1. HD = high-density.

Cisco 7120-T3, Cisco 7120-E3, Cisco 7140-2T3, and Cisco 7140-2E3 Cables

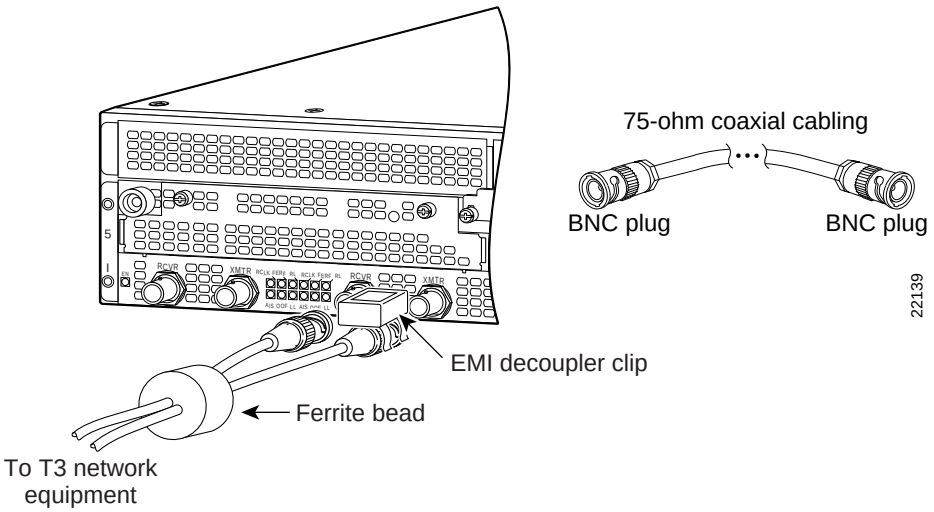
The T3 or E3 serial interface cable on the Cisco 7120 and Cisco 7140 series, which is a 75-ohm coaxial cable, is used to connect your router to a T3 or E3 serial network. Serial cables conform to EIA/TIA-612 and EIA/TIA-613 specifications. The serial ports are considered to be DTE devices.

The T3 or E3 serial port has two connectors (receive and transmit) where you connect the Cisco 75-ohm coaxial cable. The 75-ohm coaxial cable (Cisco product number CAB-ATM-DS3/E3), is available only from Cisco Systems; it is *not* available from outside commercial cable vendors.

Figure C-10 shows the Cisco 75-ohm coaxial cable, which is available in 10-foot (3.05-meter) lengths only. The typical maximum distance between stations for T3 or E3 transmissions is 1300 feet (396 meters).

Note For E3 (75-ohm) connections, you must have ferrite beads on the 75-ohm coaxial cable and electromagnetic interference (EMI) decoupling clips on the receiver end of the cable (see Figure C-10) if compliance with European certification standards for emission control is required (EN55022/CISPR22 Class B for radiated emission levels).

Figure C-10 T3 and E3 Serial Port Adapter Cables



The T3 and E3 ports support several types of integrated data service units (DSUs). Table C-17 lists the features supported.

Table C-17 Feature Compatibilities of T3 and E3 Serial Port DSUs

Device	Full Rate	Scrambling	Subrate	MDL[1]
T3 DSU				
DL3100	Yes	Yes	Yes	No
Kentrox	Yes	Yes[2]	Yes[2]	No
Larscom	Yes	Yes	Yes	No
E3 DSU				

Table C-17 Feature Compatibilities of T3 and E3 Serial Port DSUs (continued)

Device	Full Rate	Scrambling	Subrate	MDL[1]
DL3100E	Yes	No[3]	Yes[3]	No
Kentrox	Yes	Yes[2]	Yes[2]	No

1. MDL = Maintenance Digital Link.
2. T3 and E3 serial ports support either scrambling or Kentrox subrate, not both at the same time.
3. DL3100E does not support scrambling. However, the E3 serial port can turn on scrambling in DSU mode 0 for connecting to another E3 serial port. The E3 serial port supports either scrambling (in mode 0) or DL3100E subrate, not both at the same time.

Cisco 7120-AT3, Cisco 7140-2AT3, Cisco 7120-AE3, Cisco 7140-2AE3, Cisco 7120-SMI3, and Cisco 7140-2MM3 Cables

The AT3, AE3, MM3 (OC-3c/STM-1 multimode), and SMI3 (OC-3c/STM-1 single-mode intermediate reach) interfaces in Cisco 7120 series and Cisco 7140 series routers are full duplex. You must use the appropriate ATM interface cable to connect the interface with an external ATM network. These interfaces are considered DTE devices.

Table C-18 summarizes the interface types, connectors, and cables.

Table C-18 AT3, AE3, MM3, and SMI3 Connector Types and Cables

Interface	Rate (Mbps)	Connector Type	Cable Type	ITU-T G.957 Standard	Bellcore GR-253 Standard	Wave-length	Maximum Distance
AT3	44.736	BNC	Coaxial	–	–	–	450 ft (137.2 m)
AE3	34.368	BNC	Coaxial	–	–	–	1250 ft (381 m)
MM3	155.52	SC	62.5/125 microns multimode	Intra-office STM-1 I-1	Short reach OC3	1310 nm	1.2 mi (2 km)
SMI3	155.52	SC	9 microns single mode	Short-haul STM-1 S-1.1	Intermediate reach OC3	1310 nm	9.3 mi (15 km)

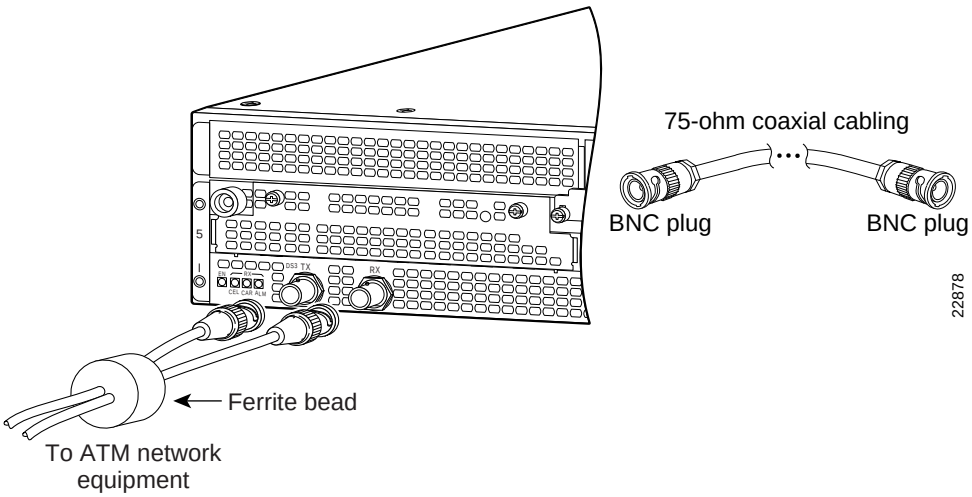
Note The ATM port is considered a DTE device.

AT3 and AE3 Cables and Receptacles

The AT3 and AE3 interfaces provide an interface to ATM switching fabrics for the bidirectional transmission and reception of data at rates of up to 45 Mbps (for T3) and 34 Mbps (for E3).

The AT3 and AE3 interfaces use a 75-ohm coaxial interface cable to connect your router to an ATM T3 or E3 network. The AT3 and AE3 cables (see Figure C-11) conform to EIA/TIA-612 and EIA/TIA-613 specifications. The AT3 and AE3 ports are considered DTE devices.

Figure C-11 AT3 and AE3 Cables



AT3 or AE3 ports consist of two connectors, transmit and receive. The 75-ohm coaxial cable (Cisco product number CAB-ATM-DS3/E3) is available only from Cisco Systems; it is *not* available from outside commercial cable vendors.

The Cisco 75-ohm coaxial cable is available only in 10-foot (3.05-meter) lengths. The typical maximum distance between stations for T3 and E3 transmissions is 1300 feet (396 meters).

Note To ensure compliance with EMI and European certification standards for emission control (EN55022/CISPR22 Class B for radiated emission levels), the transmit and receive cables should be tied together along their entire length, and ferrite beads should be installed on each cable near the transmit and receive connectors.

MM3 and SMI3 Cables and Receptacles

The MM3 (OC-3c/STM-1 multimode) and SMI3 (OC-3c/STM-1 single-mode intermediate reach) interfaces provides an interface to ATM switching fabrics for transmitting and receiving data at rates of up to 155 Mbps bidirectionally. The MME and SMI3 interfaces connect to SONET/SDH, 155-Mbps multimode or single-mode optical fiber.

For SONET/SDH multimode and SONET/SDH single-mode connections, use one duplex SC connector (see Figure C-12) or two simplex SC connectors (see Figure C-13). The simplex and duplex SC connectors are shipped with removable dust covers on each connector.

Figure C-12 Duplex SC Connector

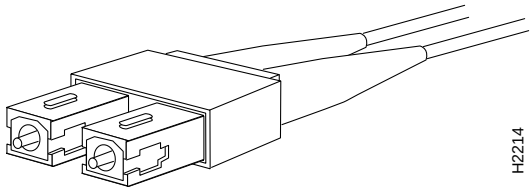
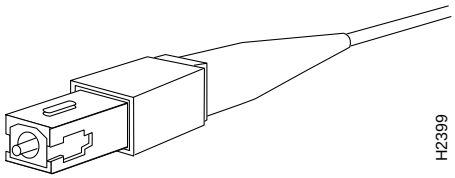


Figure C-13 Simplex SC Connector



An OC-3 ATM interface cable, which is used to connect your router to an external DSU (an ATM network), is available for use with the MM3 and SMI3 interfaces. Cables can be obtained from an outside cable vendor.

Single-mode and multimode cables should perform to the specifications listed in Table C-19.

Table C-19 Fiber-Optic Cable Specifications

Standard	Maximum Path Length	Cabling
ISO/IEC 9314-3	1.2 miles (2 km) all cables in a connection, end to end	62.5-micron core with an optical loss of 0–9 dB, or 50-micron core with an optical loss of 7 dB
IEC 793-2	24.8 mi (40 km) for SML[1] and 9.3 mi (15 km) for SMI[2]	9-micron core
ANSI/TIA/EIA-492CAAA	24.8 mi (40 km) for SML and 9.3 mi (15 km) for SMI	9-micron core

1. SML = single-mode long reach.
2. SMI = single-mode intermediate reach.

Note A single fiber link should not mix 62.5- and 50-micron cable.

Fiber-Optic Transmission Specifications

The following sections describe the SONET specifications for fiber-optic transmissions, define the power budget, and help you approximate the power margin for multimode and single-mode transmissions.

For more information on determining attenuation and power budget, see the following publications:

- T1E1.2/92-020R2 ANSI, the Draft American National Standard for Telecommunications entitled *Broadband ISDN Customer Installation Interfaces: Physical Layer Specification*.
- *Power Margin Analysis, AT&T Technical Note,* TN89-004LWP, May 1989

SONET Distance Limitations

The SONET specification for fiber-optic transmission defines two types of fiber: single mode and multimode. Modes can be thought of as bundles of light rays entering the fiber at a particular angle. Single-mode fiber allows only one mode of light to propagate through the fiber, whereas multimode fiber allows multiple modes of light to propagate through the fiber. Because multiple modes of light propagating through the fiber travel different distances depending on the entry angles, causing them to arrive at the destination at different times (a phenomenon called modal dispersion), single-mode fiber is capable of higher bandwidth and greater cable run distances than multimode fiber.

The typical maximum distances for single-mode and multimode transmissions, as defined by SONET, are in Table C-20. If the distance between two connected stations is greater than this maximum distance, significant signal loss can result, making transmission unreliable.

Table C-20 SONET Maximum Fiber-Optic Transmission Distances

Transceiver Type	Maximum Distance between Stations[1]
Single-mode long reach (SML)	Up to 24.8 miles (40 kilometers)
Single-mode intermediate reach (SMI)	Up to 9.3 miles (15 kilometers)
Multimode (MM)	Up to 1.2 miles (2 kilometers)

1. Table C-20 gives typical results. Use the power budget calculations described in the following sections to determine the actual distances.

Power Budget

To design an efficient optical data link, evaluate the power budget. The power budget is the amount of light available to overcome attenuation in the optical link and to exceed the minimum power that the receiver requires to operate within its specifications. Proper operation of an optical data link depends on modulated light reaching the receiver with enough power to be correctly demodulated.

Attenuation, caused by the passive media components (cables, cable splices, and connectors), is common to both multimode and single-mode transmission.

The following variables reduce the power of the signal (light) transmitted to the receiver in multimode transmission:

- Chromatic dispersion—Spreading of the signal in time because of the different speeds of light wavelengths
- Modal dispersion—Spreading of the signal in time because of the different propagation modes in the fiber

Attenuation is significantly lower for optical fiber than for other media. For multimode transmission, chromatic and modal dispersion reduce the available power of the system by the combined dispersion penalty (dB). The power lost over the data link is the sum of the component, dispersion, and modal losses.

Table C-21 lists the factors of attenuation and dispersion for typical fiber-optic cable.

Table C-21 Typical Fiber-Optic Link Attenuation and Dispersion Limits

Limits	Single-mode	Multimode
Attenuation	0.5 dB/km	1.0 dB/km
Dispersion	No limit	500 MHz/km[1]

1. The product of bandwidth and distance must be less than 500 MHz/km.

Approximating the MM3 and SMI3 Port Power Margin

The LED used for a multimode transmission light source creates multiple propagation paths of light, each with a different path length and time requirement to cross the optical fiber, causing signal dispersion (smear). Higher-order mode loss (HOL) results from light from the LED entering the fiber and being radiated into the fiber cladding. A worst-case estimate of power margin (PM) for multimode transmissions assumes minimum transmitter power (PT), maximum link loss (LL), and minimum receiver sensitivity (PR). The worst-case analysis provides a margin of error; not all of the parts of an actual system will operate at the worst-case levels.

The power budget (PB) is the maximum possible amount of power transmitted. The following equation lists the calculation of the power budget:

PB = PT – PR

PB = –20 dBm – (–30 dBm)

PB = 10 dB

The power margin calculation is derived from the power budget minus the link loss, as follows:

PM = PB – LL

If the power margin is positive, the link will work.

Table C-22 lists the factors that contribute to link loss and the estimate of the link loss value attributable to those factors.

Table C-22 Link Loss Factors and Values

Link Loss Factor	Estimate of Link Loss Value
Higher-order mode losses	0.5 dB
Clock recovery module	1 dB
Modal and chromatic dispersion	Dependent on fiber and wavelength used
Connector	0.5 dB

Table C-22 Link Loss Factors and Values (continued)

Link Loss Factor	Estimate of Link Loss Value
Splice	0.5 dB
Fiber attenuation	1 dB/km

After calculating the power budget minus the data link loss, the result should be greater than zero. Circuits whose results are less than zero may have insufficient power to operate the receiver.

The SONET specification requires that the signal must meet the worst-case parameters listed in Table C-23.

Table C-23 MM3 and SMI3 Port SONET Signal Requirements

Variable	Single Mode (SML)	Single Mode (SMI)	Multimode
PT	–5 dBm	–15 dBm	–20 dBm
PR	–34 dBm	–31 dBm	–30 dBm
PB	29 dBm	16 dB	10 dB

Multimode Power Budget Example with Sufficient Power for Transmission

The following is an example multimode power budget calculated based on the following variables:

- Length of multimode link = 3 kilometers (km)
- Four connectors
- Three splices
- Higher-order mode loss (HOL)
- Clock recovery module (CRM)

Estimate the power budget as follows:

PB = 10 dB – 3 km (1.0 dB/km) – 4 (0.5 dB) – 3 (0.5 dB) – 0.5 dB (HOL) – 1 dB (CRM)

PB = 10 dB – 3 dB – 2 dB – 1.5 dB – 0.5 dB – 1 dB

PB = 2 dB

The positive value of 2 dB indicates that this link would have sufficient power for transmission.

Multimode Power Budget Example of Dispersion Limit

Following is an example with the same parameters as the previous example, but with a multimode link distance of 4 km:

PB = 10 dB – 4 km (1.0 dB/km) – 4 (0.5 dB) – 3 (0.5 dB) – 0.5 dB (HOL) – 1 dB (CRM)

PB = 10 dB – 4 dB – 2 dB – 1.5 dB – 0.5 dB – 1 dB

PB = 1 dB

The value of 1 dB indicates that this link would have sufficient power for transmission. But, due to the dispersion limit on the link (4 km x 155.52 MHz > 500 MHz/km), this link would not work with multimode fiber. In this case, single-mode fiber would be the better choice.

Single-Mode Transmission

The single-mode signal source is an injection laser diode. Single-mode transmission is useful for longer distances, because there is a single transmission path within the fiber and smear does not occur. In addition, chromatic dispersion is also reduced because laser light is essentially monochromatic.

The receiver for single-mode intermediate reach (SMI) cannot be overloaded by the SMI transmitter and does not require a minimum fiber cable length or loss. The maximum receive power for single-mode long reach (SML) is –10 dBm, and the maximum transmit power is 0 dBm. The SML receiver can, therefore, be overloaded when short lengths of fiber are used. Overloading the receiver will not damage the receiver but can cause unreliable operation. To prevent overloading an SML receiver connected with short fiber links, insert a minimum 10-dB attenuator on the link between any single-mode long-reach transmitter and the receiver.

SONET Single-Mode Power Budget Example

The following example of a single-mode power budget assumes 2 buildings, 8 kilometers apart, connected through a patch panel in an intervening building with a total of 12 connectors.

- Length of single-mode link = 8 km
- 12 connectors

Estimate the power budget as follows:

PM = PB – LL

PM = 16 dB – 8 km (0.5 dB/km) – 12 (0.5 dB)

PM = 16 dB – 4 dB – 6 dB

PM = 6 dB

The value of 6 dB indicates that this link would have sufficient power for transmission and is not in excess of the maximum receiver input power.

Using Statistics to Estimate the Power Budget

Statistical models more accurately determine the power budget than the worst-case method. Determining the link loss with statistical methods requires accurate knowledge of variations in the data link components. Statistical power budget analysis is beyond the scope of this document. For further information, refer to UNI Forum specifications, ITU-T standards, and your equipment specifications.

Symbols

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